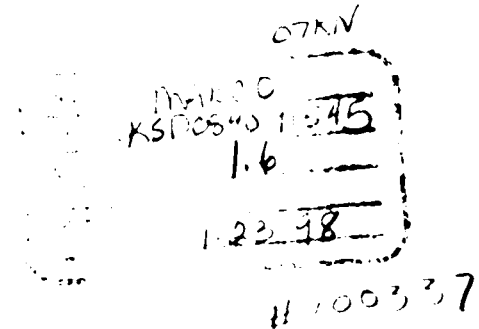


**Golder Associates Inc.**

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Telephone (303) 980 0540  
Fax (303) 985 2080



**DRAFT REPORT ON  
PHASE I INVESTIGATION OF  
CONTAMINANT MIGRATION  
OFF-SITE OF THE MARCO SITE  
CHANUTE, KANSAS**

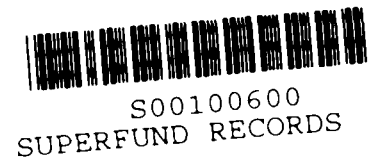


*Prepared for:*

*Kansas Department of Health and Environment  
Forbes Field, Building 740  
Topeka, Kansas 66620-0001*

*Prepared by:*

*Golder Associates Inc.  
200 Union Blvd., Suite 500  
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January 23, 1998

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**KANSAS**  
**DEPARTMENT OF HEALTH & ENVIRONMENT**  
BILL GRAVES, GOVERNOR  
Gary R. Mitchell, Secretary

---

March 6, 1998

Janice Kroone, EPA OSC  
1201 North Santa Fe Avenue  
Chanute, Kansas 66720

Subject: Draft Report of Phase I Comprehensive Investigation of Contaminant Migration  
Off-Site of the MARCO Site, Chanute, Kansas

Dear Ms. Kroone:

As we discussed by telephone I am furnishing you with a copy of a Draft Report of the Kansas Department of Health and Environment's (KDHE) Phase I Comprehensive Investigation of Off-Site Contaminant Migration of the MARCO Site, Chanute, Kansas. KDHE intends to accept the report as Final requiring no changes.

Mr. Randy March, representing Golder Associates, Inc., the contractor conducting the off-site investigation for KDHE, will be contacting you soon concerning access to the MARCO property for sampling purposes. Mr. March is Golder's project manager for this investigation and he wishes to discuss with you your requirements while he is sampling on MARCO property. I have advised him of the areas near the south and east property site borders in which his investigation will be confined to avoid EPA activities now taking place on the MARCO property.

If you have any questions please call me.

Sincerely,

Tom Peterson  
Environmental Geologist  
Voluntary Cleanup and State Water Plan Unit  
Bureau of Environmental Remediation  
(785) 296-5555

C: Susan Stover--> file





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**DRAFT REPORT ON  
PHASE I INVESTIGATION OF  
CONTAMINANT MIGRATION  
OFF-SITE OF THE MARCO SITE  
CHANUTE, KANSAS**

**RECEIVED**

**JAN 27 1998**

**BUREAU OF  
ENVIRONMENTAL  
REMEDATION**

*Prepared for:*

*Kansas Department of Health and Environment  
Forbes Field, Building 740  
Topeka, Kansas 66620-0001*

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## 1.0 INTRODUCTION

This report describes Phase I of a Comprehensive Investigation (CI) of off-site soil and groundwater contamination near the Mid America Refining Company (MARCO) site in Chanute, Kansas. The MARCO site is a former petroleum refinery with suspected off-site migration of contaminants consisting primarily of BTEX (benzene, toluene, ethylbenzene, and xylene) and related petroleum compounds.

The CI is being performed by Golder Associates Inc. (Golder) on behalf of the Kansas Department of Health (KDHE) under the State Water Plan and Contract No. 31060. Phase I activities were conducted based on the December 4, 1997 *Work Plan for Comprehensive Investigation Off-Site of the MARCO Site, Chanute, Kansas* (Golder 1997).

### 1.1 Project Objectives

Scoping documentation provided by KDHE indicates that the U.S. EPA is responsible for investigation of contamination within the boundaries of the MARCO property. Since the purpose of Golder's study is to investigate contamination that migrated off-site from the MARCO facility, the CI is to focus on the following objectives.

- ▶ Investigate the nature and fully delineate the extent of soil and groundwater contamination off-site of the MARCO property.
- ▶ Identify any human and/or environmental targets in the area and identify all domestic water well users located in the impacted area. A water sample is to be collected from all water wells within the impacted area and analyzed for VOCs (volatile organic compounds). Golder is to furnish KDHE with the names and mailing addresses of the well owners, the use of the well, and a copy of the analytical results as they are received by Golder. KDHE will notify the well owners of the analytical results.
- ▶ Establish the groundwater flow direction in the study area.





## 1.2 Investigative Scope

The standard KDHE Scope of Work (SOW) for a CI was received as an attachment to the October 3, 1997 CI request received from KDHE. As a result of discussions with KDHE, standard SOW components 1 and 5 were to be excluded from the MARCO investigation; component 1 (Historical Evaluation and Site Description) was completed previously, and component 5 (Risk Assessment) is not necessary at this time. Based on the SOW issued by KDHE and subsequent discussions with KDHE, Golder was to focus on investigative components 2, 3, 4, and 6, as summarized below.

**2. Study Area Investigation** - A description of the physical characteristics of the study area, including but not limited to geology, soils, hydrogeology, surface water hydrology, land use, and meteorology. In accordance with the objectives described in Section 1.1, hydrogeologic characteristics were emphasized.

**3. Source Characterization** - A description of the field activities used to determine and describe the source(s) and release characteristics. Since the U.S. EPA is the lead agency in investigating the MARCO property, Golder's source characterization activities at the MARCO site were limited to sampling of KDHE monitoring wells that were installed at the site in 1986.

**4. Nature and Extent Characterization** - A study to determine the horizontal and vertical extent of contamination in soil, groundwater, and surface water, and evaluation of transport pathways.

**6. Identification of Corrective Action Alternatives** - Based on data from the CI, develop an initial list of corrective action alternatives that will be evaluated during the Corrective Action Study (CAS).

## 1.3 Document Organization

This report presents the results of Phase I of the MARCO CI. Background information pertinent to the CI is presented in Section 2, Phase I investigative activities are described in



Section 3, and regional and site-vicinity conditions are described in Sections 4 and 5, respectively. Conclusions regarding the hydrogeologic/hydrochemical model for the site-vicinity, the extent of contamination, and contaminant transport pathways are presented in Section 6, and an initial list of corrective action alternatives is provided in Section 7. Recommendations for Phase II investigative activities are described in Section 8; the recommended Phase II activities are intended to address data gaps that should be filled in support of the Corrective Action Study. References cited in this report are listed in Section 9. Finally, Phase I field reports, representative Phase I photographs, Phase I data, and other supporting information are presented in Appendices A through I.



## **2.0 BACKGROUND INFORMATION**

### **2.1 General Site Description**

As shown on Figure 1, the MARCO site is located in northwest Neosho County immediately north of the city limits of Chanute, Kansas. The site is bounded: to the east by U.S. Highway 169 (Santa Fe Avenue) and several businesses; to the north by Ash Grove Road and Ash Grove Cement Company; to the west by EOTT Energy Corp.; and to the south by Hickory Street and several businesses and residences (Figure 2). The current 24.4 acre MARCO site comprises a portion of the southeast quarter of Section 17, Township 27 North, Range 18 East.

The site is situated approximately 1/2 mile south of Village Creek, an eastward flowing tributary to the Neosho River. The Neosho River is located approximately 2 miles east of the site, flows to the south in the site vicinity, and is the primary source of drinking water for the City of Chanute. The intake for the public water supply is located along the western edge of the Neosho River approximately 2 miles southeast of the site (Figure 1).

Topography in the site vicinity is characterized by moderate to gentle relief at the MARCO site and gently sloping to relatively flat areas north and east of the site. The ground surface generally slopes northeastward toward Village Creek and eastward toward the Neosho River. Surface elevations at the MARCO site range from approximately 970 feet near the southwest corner of the property to 915 feet near the northeast corner of the property, while surface elevations east of the site typically range from 915 to 905 feet. Elevations reported herein are based on the National Geodetic Vertical Datum (NGVD) of 1929.



## 2.2 MARCO Site History

Processing of crude oil was performed at the MARCO site from 1934 until the facility was shut down in February of 1981. During the period of peak production, the facility processed crude stock at a rate of approximately 2,800 barrels per day (bbl/day), resulting in 350 bbl/day of diesel fuel, 550 bbl/day of jet fuel, and 700 bbl/day of gasoline, oil, and kerosene (KDHE 1987). Asphalt was produced from the remaining crude bottom products.

Owners/operators of the site are summarized below.

<i>1934 to 1943</i>	Petroleum Products Company, Inc.
<i>1943 to ~1956</i>	Missouri Farmers Association Refining Company
<i>~1956 to 1973</i>	Mid America Refining Company
<i>1973 to 1980</i>	Kemco Petroleum Company

Since shut down of the facility in 1981, the site has been owned by Producer Group, Inc. and Chanute Engineering and Refinery Company. On July 1, 1985, 4.6 acres in the northwestern portion of the original site was sold to Fairway Crude, Inc., a crude oil purchasing company. The remaining approximate 25-acre parcel was leased to Rose Chemical Company on February 1, 1986. Although Rose Chemical planned to reactivate the old refinery and develop a PCB destruction plant at the site, these plans were stymied by public opposition. Ownership of the 24.4-acre parcel is currently in the name of the Robert Cooley Trust of Lawton, Oklahoma.

As part of a cooperative agreement with the U.S. EPA, KDHE conducted a Pre-NPL Preliminary Assessment and Site Investigation at the MARCO site in 1986. KDHE investigations at the site included monitoring well installation and sampling of groundwater, surface water, solids, and air; monitor wells installed as part of the 1986





field program are shown on Figure 2. These investigations culminated in KDHE submittal of a comprehensive report (KDHE 1987) that described what was known about the site. Much of the historical information included in this Golder report were obtained from the 1987 KDHE report and associated planning documents (KDHE 1985a, 1985b, 1986a, and 1986b). Pertinent excerpts from the 1987 KDHE report are included in Appendix A.

Prior to initiation of KDHE field investigations at the site in 1986, potential contaminant source areas were determined. It was noted that areas of alleged contamination totaled approximately 3 to 8 acres (KDHE 1986b). Portions of the site that were at least initially excluded from KDHE investigations due to suspected contamination included several waste disposal areas, as shown on Figure 2. MARCO waste products and site disposal locations are summarized below (KDHE 1986b).

- ▶ ***API Separator Sludge*** - Bottom sediments that accumulated at the API separator and waste collection facilities were placed in the BS Pit, located near the northwest corner of the site.
- ▶ ***Leaded Tank Bottoms*** - Leaded tank bottoms were placed in the south-central portion of the site approximately 5 feet west of Tank No. 17. These waste products were covered with approximately 6 to 18 inches of soil.
- ▶ ***Jet Fuel Filter Clay*** - Spent filtrol clay was mixed with fly ash and placed in the northeast portion of the site.
- ▶ ***Drum Pile*** - Unidentified drums and other containers were present in the west-central portion of the site.

Little has been done at the MARCO site since 1987. In 1993, in response to KDHE notification of a potentially hazardous condition, the U.S. EPA removed mercury from the former site laboratory. Recent activities at the site have included: 1) salvaging of selected storage tanks and pipes; and 2) U.S. EPA securing of the site by installation of fencing where adequate fencing is not currently in place. Salvaging operations at the site have



resulted in surficial releases of crude oil in portions of the site, as confirmed during an October 17, 1997 site visit by KDHE and Golder.

### **2.3 Landowner Interviews**

Interviews with site-vicinity landowners and others with historical information about site-vicinity operations were helpful in compiling information that is pertinent to investigation of off-site contamination from the MARCO site, as described below.

#### **Bill Gericke, Owner of Gericke Iron & Metal (1212 North Santa Fe Avenue)**

The Gericke scrap metal operation is located adjacent to the site immediately east of Santa Fe Avenue. Mr. Gericke reported that several excavations near his property resulted in observation of contaminated groundwater within approximately 6 feet of the ground surface, including: 1) tank excavation north of the Gericke shop area; 2) excavation at the east end of the truck scales located south of the shop area; and 3) utility trenching near the eastern edge of Santa Fe Avenue during the summer of 1997. Mr. Gericke believes that the source of the contaminated groundwater is the MARCO site.

Mr. Gericke also noted other historical operations pertinent to the current CI. He reported that a service station was located in the southern portion of what is now his property; the service station was originally owned by Ketchum Oil Company, then was purchased by Gardner Oil Company. It is also noteworthy that the area east of Santa Fe Avenue near the Gericke property was historically a swamp, but was filled to achieve the current grade. Mr. Gericke reported that prior to his purchasing the property, the previously topographically low area near his property was filled with miscellaneous debris, such as brick and household refuse.



**Corky Tasche, Owner of Corky's Used Cars (1318 North Santa Fe Avenue)**

A used car dealership, upholstery shop, and automobile body shop owned by Mr. Tasche is located near the northeast corner of the MARCO site and immediately north of the Gericke operation. Mr. Tasche confirmed that an unknown thickness of fill materials was placed in the previously swampy area east of Santa Fe Avenue. He also reported that a smelter was once located on what is now his property. Based on discussions with Mr. Tasche, a former MARCO employee, the MARCO facility produced JP-4 jet fuel and both heavy and light grades of diesel.

**Leroy Chard, Operator of Total Service Station (1125 North Santa Fe Avenue)**

A Total Service Station is located near the southeast corner of the MARCO site on the west side of Santa Fe Avenue. This service station, which was previously owned by Fina Oil and Chemical Company (Fina), has been the subject of two environmental investigations, as summarized below.

- ▶ In May of 1990, Fina removed one 7,000-gallon and two 6,000-gallon underground storage tanks (USTs) used for virgin gasoline and diesel fuel storage, and one 300-gallon waste oil UST (GTI 1990). Soils present near the gasoline/diesel UST basin were impacted by gasoline, and soils near the waste oil basin were impacted by petroleum hydrocarbons. Due to excavation constraints, not all soil impacted by petroleum hydrocarbons was removed from the excavation areas.
- ▶ A site assessment was performed at the former Fina Service Station in 1995, as reported by Geraghty & Miller in 1996. This investigation included installation of eight groundwater monitoring wells, soil sampling, and groundwater monitoring. High concentrations of BTEX were detected in groundwater samples collected from northern monitoring wells, located closest to the MARCO site. The site assessment concluded that the MARCO site was the source of the most significant groundwater contamination detected in the Fina wells (Geraghty & Miller 1996).



Groundwater monitoring wells at this service station are being sampled on an ongoing basis. Based on the most recently reported groundwater monitoring event (September 9, 1997), the groundwater flow direction is generally to the east, although northeast and southeast flow components were also indicated (Terracon 1997b, excerpts of which are provided in Appendix B-1). Consistent with the results of the 1995 investigation, BTEX concentrations were highest in monitoring wells located immediately south and southeast from the MARCO site.

Mr. Chard, the longtime operator of this service station, provided additional information on historical operations in the site vicinity. He reported that the Gardner Oil Company Service Station, which was located in the southern portion of property currently owned by Bill Gericke, was closed in approximately 1958. Two of the monitoring wells installed by Fina in 1995 are located on the east side of Santa Fe Avenue, near the former Gardner Service Station. Mr. Chard also reported that a Derby Service Station was located immediately south of the current Total Service Station; Mr. Chard noted that gasoline releases were documented at the Derby Service Station, which was closed in approximately 1989.

#### **EOTT Energy Corp.**

The EOTT Energy Corp. (EOTT) property is located immediately west of the Marco site. In approximately 1988, EOTT purchased Fairway Crude, Inc. (FCI), the crude oil purchasing company that acquired 4.6 acres of the northwest portion of the original MARCO site in 1985. Jim Fredrick of EOTT reported that in 1985, FCI installed a monitoring well adjacent to a salt water storage tank located west of the MARCO site. This well was sampled as part of the MARCO site investigation performed by KDHE in 1986. Mr. Fredrick reported that this monitoring well was decommissioned in 1987 when the storage tank was removed.





While looking for the FCI monitoring well on October 17, 1997, KDHE and Golder noted a cased borehole near the eastern edge of EOTT property. This borehole contained steel casing and was open at the ground surface. Mr. Fredrick reported that the cased borehole noted on October 17 was likely a natural gas exploration borehole that was approximately 200 feet deep when drilled; therefore, this potential monitoring location is much deeper than the uppermost aquifer zone targeted by the current investigation, and would likely not yield pertinent water quality data.

### **Jim Shea, Plant Manager for Ash Grove Cement Company**

As part of the 1986 investigation of the MARCO site, KDHE sampled a water well located north of the site on Ash Grove Cement Company property. Based on discussions with Jim Shea of the Ash Grove Cement Company, this well is no longer operational. KDHE records indicate that this well was plugged.

### **City of Chanute Public Works Department**

Trenches for underground utilities could potentially function as preferential pathways for migration of contaminants from the MARCO site. Information on site vicinity utilities was obtained from Jim James, Larry Shepard, and Carl Ware of the Chanute Public Works Department. A CAD file showing current utility lines near the MARCO site was obtained from Carl Ware, the location of abandoned water and sewer lines was obtained from Larry Shepard, and Jim James confirmed that there are no abandoned gas lines near the site. The location of current and abandoned utility lines are shown on Figure 3.

Utility trenches near the site have been excavated to various depths. Based on information provided by Larry Shepard, approximate cover depths for Chanute utility lines are as



follows: water lines covered by 3 to 3.5 feet; sewer lines covered by 8 feet; and gas lines covered by 2 feet.

Historical filling of the area near the Gericke and Tasche properties was also discussed with City of Chanute personnel. According to Larry Shepard, construction debris was primarily used to fill this area, although some household refuse could have been included.

### **William Thornton, KDHE District Geologist**

William Thornton provided information on a December 14, 1989 hazardous chemical spill that is potentially pertinent to contaminant investigations east of the MARCO site. The spill occurred near downtown Chanute when an Atchison, Topeka and Santa Fe Railway Company tank car was ruptured, releasing 19,000 gallons of Chem-Fuel K Blend, a waste solvent mixture. The Material Safety Data Sheet indicates that the two primary hazardous ingredients in Chem-Fuel K Blend are xylene (up to 60 percent) and toluene (up to 50 percent). According to laboratory analyses provided by Cadence Chemical Resources, Inc., the waste solvent mixture transported in the ruptured tank car included 17.8 percent toluene, 11.2 percent xylene, and 15.9 percent unknown solvents.

Shortly after the tank car was ruptured, it was transported about 1 mile north to a topographically low area (commonly referred to as the northern site) located approximately 600 feet east of the MARCO facility, as shown on Figure 2. Cleanup crews estimated that "perhaps 60 percent of the spillage had occurred at the north site" (KDHE 1990); this suggests that approximately 11,000 to 12,000 gallons of Chem-Fuel K Blend was released in an area inferred to be hydraulically downgradient from the MARCO site.

Cleanup of the northern spill area was initiated on December 20, 1989. The northern spill site "was located within a demolition dump area of kiln dust, lumber, rock debris, and



soil," resulting in visible contamination extending to a depth of 1.5 feet (KDHE 1990). Excavation at the northern site typically extended to depths ranging from 2 to 3 feet, resulting in approximately 900 tons of soil being removed. KDHE directed that site cleanup criteria be consistent with Toxicity Characteristic Leaching Procedure (TCLP, 40 CFR Ch. 1, Appendix 1) contaminant concentrations. Materials excavated from the northern spill area were transported for off-site disposal.

Surface water samples were collected from the northern spill area in January 1990 and June 1990. Laboratory analyses for the January 1990 sampling event indicated toluene at 3.49 parts per million (ppm), while the June 1990 sampling event indicated toluene at 0.213 ppm. Based on the composition of Chem-Fuel K Blend and the results of surface water sampling performed during the site cleanup, potential releases to the groundwater from the MARCO site could be difficult to distinguish from potential releases attributable to the waste solvent spill area located east of the MARCO site, particularly considering the presence of organic constituents such as toluene.

## **2.4 Surface Conditions**

### **2.4.1 Surficial Soils**

The primary surficial soil types in the site vicinity are the Osage silty clay and the Bates loam (USDA 1982). The Osage silty clay, which is a flood plain deposit, is present in the eastern portion of the study area (Figure 4). Permeability values for the Osage silty clay are generally less than  $4 \times 10^{-5}$  centimeters per second (cm/sec). The Bates loam, which is present in the topographically higher areas located west of the flood plain, is better drained than the Osage silty clay, and is generally comprised of 15 percent clay. The Bates loam is characterized by permeability values ranging from  $10^{-2}$  to  $10^{-4}$  cm/sec.



#### 2.4.2 Surface Water

Surface water at the MARCO site flows eastward toward Santa Fe Avenue, where it discharges into an ephemeral drainage located north of the site. This ephemeral drainage discharges into Village Creek, a tributary to the Neosho River (Figure 1). MARCO operational plans called for site runoff to be collected at an oil/water separator and pumping facility located in the eastern portion of the site. However, while the site was operating, the capacity of the separator/pump facility was exceeded during periods of high rainfall, resulting in off-site discharge of potentially contaminated surface water. KDHE file review indicated that historical contamination of Village Creek was attributed to contaminated runoff from the MARCO site (KDHE 1987); this contamination was documented as early as 1940.

In the site vicinity, surface water flow is to the east (Neosho River) and north (Village Creek). Surface water drainage is poor in the vicinity of the railroad tracks located east of the site. This swampy area was the location of a waste solvent spill in 1989, as described in Section 2.3.

As part of the 1986 KDHE investigation, three surface water samples were collected from areas suspected of receiving contaminated discharges from the MARCO site, as shown on Figure 2. Results of this sampling program, which are included in Appendix A, are summarized below.

- ▶ **MASW1** was collected near the northern site boundary. Although hydrocarbon staining was noted near the sampling site, VOCs were not detected.
- ▶ **MASW2** was collected from an on-site pond coated with tarry hydrocarbons; VOCs were not detected.





- ▶ **MASW3** was collected near the eastern site boundary. Although hydrocarbon staining was observed, VOCs were not detected.

Therefore, although surface water sampling near the MARCO site indicated the presence of hydrocarbons, priority pollutants were not detected. Based on the results of the 1986 surface water sampling program and the groundwater emphasis for the MARCO CI, additional surface water quality sampling was not performed in connection with the Phase I investigative activities.



### **3.0 PHASE I INVESTIGATION**

Phase I investigative activities at the MARCO site were performed by Golder and its subcontractor, Hydro-LOGIC, Inc. (HLI) of Eudora, Kansas, a State of Kansas licensed water well contractor (license #602). Investigative field activities conformed to the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP) presented in the MARCO CI Work Plan (Golder 1997).

The Phase I investigation was performed during the week of December 8, 1997. Daily field reports summarizing the Phase I activities are presented in Appendix C, and photographs of the significant Phase I investigation components are included in Appendix D.

#### **3.1 Preliminary Operations**

Prior to the initiation of Phase I drilling activities, Golder contacted pertinent utility and City of Chanute personnel to arrange the necessary utility clearances. Golder personnel arrived on site to flag drilling locations and then observed and documented the subsequent site utility clearance. A KDHE Utility Clearance Checklist was submitted to KDHE prior to the initiation of drilling activities on December 9, 1997.

Concurrent with the site-wide utility clearance, Golder personnel contacted landowners who had previously agreed to allow property access during investigative activities. Golder viewed the proposed drilling locations with the landowners and addressed questions or concerns pertaining to drilling activities.

Additionally, water levels in the three KDHE wells that are located within the MARCO property boundary were measured. Calculated water level elevations for wells M1, M3,



and M4 confirmed that the overall direction of groundwater flow was to the east in the site vicinity. The confirmation of the site flow direction helped to validate the appropriateness of the proposed probe hole locations.

## **3.2 Field Operations**

### **3.2.1 Drilling Program**

HLI performed drilling operations using a truck mounted, SIMCO Earthprobe 200™ “direct push” sampling unit. During the field investigation 20 probe locations near the MARCO facility were advanced to bedrock refusal. Probe locations are shown on Figure 5. Of these 20 sample locations, 11 are located around the site perimeter (P-1 to P-11), and nine additional sampling locations (P-12 to P-20) are located downgradient of the site, within approximately 900 feet from the facility boundary. Probe hole locations P-7, P-8, and P-9 are located hydraulically upgradient from the MARCO facility.

## **Soil Coring**

The HLI “direct push” unit was used to obtain core samples for stratigraphic determination at all 20 probe hole locations. Contaminant screening samples were collected at all probe hole locations with the exception of probe hole P-1.

Continuous core soil samples were collected using a 48-inch long, 1.75-inch ID (inside diameter) open barrel sampler fitted with disposable, acetate liners. The core barrel was driven by 2-inch OD (outside diameter), flush-threaded hollow probe rods (HPRs). During drilling the core barrel was retrieved after every 4 feet of advancement and the full sleeve was replaced with a new liner. This methodology was utilized until drilling refusal was observed, typically at the bedrock contact. Solid stem augers of 3-inch diameter were used



to drill through cemented zones. A representative photograph of the "direct push" rig is provided as Photo D-1A of Appendix D.

Soil core material was extruded from the acetate liner and placed on clean plastic for inspection, field screening, and logging. A representative photograph of the extruded soil core is provided as Photo D-1B of Appendix D. Geologic samples were logged by Golder personnel according to Golder Technical Procedure (TP) 1.2-5 (Drilling, Sampling, and Logging of Soils), TP 1.2-6 (Field Identification of Soil), and the Unified Soil Classification System (USCS, as described on Figure E-1 of Appendix E. Soil borehole logs for probe holes P-1 through P-20 are provided in Appendix E.

### **Soil Screening**

Soil screening samples were collected at all probe hole locations except P-1. Following core extrusion, a soil sample was collected from immediately above the water table, placed in a sample bottle and promptly cooled to 4° Celsius. The sample was then screened by HLI using the trailer-mounted, self-contained mobile analytical laboratory. Soil screening samples are discussed in Section 3.3.2.

Contaminant screening of the recovered soil core was accomplished using a Photovac Microtip MP-1000 Photoionization Detector (PID). Prior to its use the PID was calibrated according to manufacturer specifications, using 100 ppm isobutylene calibration gas. At 2-foot intervals, sections of core were isolated in plastic bags and PID readings were taken directly from the bag. This method was used to minimize the influence of contaminants not associated with the soil sample. Intervals where core PID readings exceeded background levels were recorded in the remarks column on the soil borehole log (Appendix E).





Probe holes not converted to mini-wells were plugged per State requirements. Enviroplug™ medium grit, high solids sodium bentonite was used to seal borings to just below ground surface. Then native surface materials were used to restore the surface to it's original condition. All soil core material was containerized at the drill site and then placed within a concrete-lined truck scale vault at the MARCO property site. Waste water generated during decontamination of drilling equipment was containerized in DOT approved 55-gallon drums. A screening sample was then taken from the drum and sent to the mobile laboratory for analysis. The contents of the drums were disposed of on the ground following confirmation that contaminants were not detected in the waste water.

Prior to and following drilling activities all drilling equipment and materials were thoroughly decontaminated. Decontamination procedures involved thorough scrubbing with a potable water and non-phosphorus soap (Liquinox™) solution, followed by a triple rinse of potable water. Additionally, drilling personnel used new disposable latex gloves at each drilling location. These sanitary practices were used to limit the possibility of cross-contamination between probe hole locations during field activities.

### **Groundwater Screening**

The HLI "direct push" unit was used to obtain groundwater samples for contaminant screening. At probe locations where a mini-well was not installed, the groundwater screening probe was driven to the bedrock contact following soil coring activities. The well point sampling tool used is 1-inch OD x 0.76-inch ID x 24 inches long and has 15 mill-cut slots, each 2 inches long and 0.020-inch wide. The sample tool was advanced down-hole using 1-inch OD x 0.76-inch x 24-inch flush threaded HPRs.

After the mill-slotted sampler was advanced into position, polyethylene tubing was lowered into the sampler. A groundwater sample was collected using the hydroprobe vacuum



system to draw the sample to the surface. A minimum of three tubing volumes was purged prior to collecting the groundwater sample. Groundwater screening samples are further discussed in Section 3.3.3.

### 3.2.2 Mini-Wells

#### **Well Installation**

To supplement existing monitor well data near the MARCO site, 11 of the Phase I probe holes were converted to mini-wells (Table 1 and Figure 5). Of the six mini-wells installed around the site perimeter, two wells (P-7 and P-9) were installed upgradient, one well (P-6) was installed immediately south, one well (P-10) was installed immediately north, and two wells (P-2 and P-4) were installed immediately downgradient. Four mini-wells were installed at locations further downgradient from the MARCO site. These wells were placed to monitor historically problematic areas including: downgradient from KDHE monitor well M1 (P-14 and P-19); the existing and former service station locations near the southeast corner of the MARCO site (P-16), and; the 1989 railroad tank car solvent spill site (P-18). Additionally, P-12 was installed to allow evaluation of whether a groundwater flow component trends to the northeast towards Village Creek.

In accordance with State requirements, groundwater mini-well locations were drilled to a minimum of 10 feet bgs using 2.25-inch ID by 6-inch OD hollow stem augers. The augers were left in place during subsequent coring, sampling, and mini-well installation to ensure that the boring would not collapse as a result of probing vibrations.

Following the completion of coring activities, 2-inch OD HPRs with a steel anchor drive point were advanced through the center of the augers to the desired well completion depth. The HPRs were then pulled up approximately 3 inches and nominal 1-inch diameter,



schedule 40 PVC well screen and riser pipe were lowered through the HPRs to the bottom of the boring (see Photo D-2A of Appendix D). The well string was then attached to the anchored drive point by male-female threading. Ten feet of 0.010-inch mill-slotted well screen was used in each well, with the exception of locations P-7 and P-9, where 5-foot screens were required because of the shallow depth to bedrock. The wells were sand packed with 12-40 grit sand that was gravity fed and typically, extended 2 to 3 feet above the top of the well screen. After the well was set the HPRs were withdrawn, and high solids sodium bentonite chips (medium size Enviroplug bentonite) were gravity fed through the augers as they were removed from the ground. The use of hollow stem augers helped to ensure a complete seal from at or below the water table to near ground surface. In addition to the monitor well construction logs provided in Appendix F, mini-well construction details are summarized in Table 1. KDHE Water Well Record forms were submitted by HLI for each of the Phase I mini-wells.

Surface completion's were above-grade and flush-mount, depending on the proximity of the well to trafficked areas. Above-grade surface completions include probe hole locations P-7, P-9, P-18, and P-19. Above-ground completions were protected by 4-inch x 4-inch square steel casing with lockable lids. Additionally, 4-inch diameter bumper posts, approximately 3 feet high, were placed on either side of the protective casing to help prevent accidental damage. A typical above-grade completion is shown in Photo D-3A of Appendix D. The remaining mini-well locations were flush-mount completions; Mr. Don Taylor of the KDHE Bureau of Water, Industrial Program Section authorized these flush-mount completions in a letter to HLI. Both types of completions include sloping, 2-foot square by 6-inch thick concrete pads and lockable caps. A schematic view of a flush-mount completion is provided as Figure 6. A typical flush-mount completion is presented as Photo D-3B of Appendix D.



Probe hole and mini-well locations were surveyed by Cornerstone Surveying of Cherryvale, Kansas. Elevations are based upon U.S.C. & G.S. Benchmark "X 245 1934" and adjusted to the National Geodetic Vertical Datum (NGVD) of 1929. Probe hole survey locations, ground surface, and top of casing (TOC) elevations for the Phase I mini-wells are summarized in Table 1.

### **Well Development/Sampling**

The mini-wells were developed using the Hydroprobe vacuum system (see Photo D-2B of Appendix D). Static water levels were measured prior to development and casing volumes were calculated. A minimum of five well casing volumes were removed during purge activities and field parameters of pH, temperature, and conductivity were recorded approximately every casing volume. Stabilization of these parameters, combined with visual observation that purge water was clearing of sediment, generally indicates that development is complete and formational water is being removed. Parameter stabilization was defined as less than a  $\pm 10$  percent change during three consecutive readings. Following parameter stabilization, groundwater screening samples were collected as discussed in Section 3.3.3. Mini-well development and parameter information is summarized on Golder's well development data sheets provided in Appendix G.

Waste water generated during development, sampling, and decontamination activities was containerized in DOT approved 55-gallon drums. A screening sample was taken from the drum and sent to the mobile laboratory for analysis. The drums contents were disposed of on the ground following confirmation that contaminants were not detected in the waste water. Waste water from sample locations that were apparently contaminated were combined into a single drum. This DOT approved 55-gallon drum was sealed, labeled, and secured within the MARCO property boundary.





Prior to and following development activities all sample equipment and materials were thoroughly decontaminated. Polyethylene tubing was not re-used and was disposed of properly. Decontamination procedures involved thorough scrubbing with a potable water and non-phosphorus soap (Liquinox™) solution, followed by a triple rinse of potable water. Additionally, drilling personnel used new disposable latex gloves at each well location. These sanitary practices were used to limit the possibility of cross-contamination between probe hole locations during field activities.

### **3.3 Sample Collection**

#### **3.3.1 QA/QC Sample Types**

In addition to the groundwater and soil screening samples collected at each sample location described herein, QA/QC samples were collected as appropriate to monitor laboratory and field procedures. HLI collected internal QA/QC samples to monitor mobile laboratory performance. Concurrent with sampling activities, Golder collected QA/QC samples to be analyzed by an independent laboratory. Off-site analytical laboratory testing was performed by Pace Analytical Services, Inc. (Pace) of Lenexa, Kansas. Analytical testing was performed in accordance with U.S. EPA SW-846 and the methods and QA/QC protocol described in the Pace Assurance Plan previously submitted to KDHE. The following paragraphs describe the Phase I QA/QC sampling protocol.

#### **Trip Blank**

A trip blank is a laboratory-prepared volatile organic compound (VOC) sample bottle containing clean water that accompanies the sample cooler from the laboratory, to the job site, and then back to the laboratory. Typically, one set of trip blanks per sample cooler are analyzed for the contaminants of concern upon return to the laboratory. The intention



of a trip blank is to verify that primary sample bottles have not been contaminated during the time away from the laboratory. Pace provided one set of trip blanks for the Phase I investigation. Analytical results for this sample are provided in Appendix I.

### **Duplicates**

Duplicate samples were collected by sampling personnel in a manner identical to the primary sample. The duplicate sample is intended to verify that the results from the primary sample are accurate and reproducible. Four internal duplicate samples (3 soil and 1 groundwater) were collected by HLI during field activities. Analytical results for duplicate samples P5-S-1, P6-S-1, P15-S-1, and P18-W-1 are provided in Appendix H. Ten duplicate samples (3 soil and 7 groundwater) were collected by Golder concurrent with field screening sample collection. Duplicate samples P2-W-1D, P3-W-1D, P7-W-1D, P7-S-1D, P14-W-1D, P14-S-1D, P15-W-1D, P18-W-1D, P18-S-1D, and P20-W-1D were sent to Pace laboratories for independent analysis. Analytical results for these duplicate samples are provided in Appendix I.

#### **3.3.2 Soil Screening Samples**

Using the methodology discussed in Section 3.2.1, soil screening samples were collected from all probe hole locations, with the exception of location P-1. Soil samples were collected from immediately above the water table, placed in a labeled 100 ml glass containers, and immediately cooled to 4° Celsius.

Soil screening samples were delivered to the HLI on-site mobile analytical laboratory. This laboratory is equipped with an SRI 8610 (FID/PID) gas chromatograph with a U.S. EPA purge and trap, dry electrolytic conductivity detector (DELCD) and a 10-port auto-sampler. Soil samples were analyzed by HLI for the parameters shown in Table 2 using



Method 8021. Detection limits for soil sample field screening analyses were 10 ppb for purgeable aromatics and 5 ppb for purgeable halocarbons. In addition, to allow evaluation of possible jet fuel contamination, soil samples were field screened for total petroleum hydrocarbons (TPH) using Method OA-2 with a detection limit of 1 ppm.

Duplicate soil samples collected for off-site analysis were sent to the Pace laboratory and were subject to the methodologies stated above. Throughout duplicate sample collection and shipment strict chain-of-custody (COC) procedures were followed. Soil sample results and COC forms for on-site and off-site analysis are provided in Appendix H and Appendix I, respectively. A summary of contaminants detected in wells sampled by Golder and HLI during the Phase I investigation is provided in Table 3.

### 3.3.3 Groundwater Screening Samples

Groundwater screening samples were collected from open borehole and mini-well locations using the methodologies discussed in Sections 3.2.1 and 3.2.2, respectively. Following proper purge/development protocol, groundwater samples were collected at each probe hole location. For site screening samples, two 40 ml unpreserved VOC bottles were slowly filled, minimizing turbulent flow and the introduction of bubbles. The vials were slightly overfilled, creating a meniscus, and then capped. The bottles were then inspected for the presence of bubbles, labeled, and immediately cooled to 4° Celsius.

Groundwater screening samples were analyzed on site by an HLI portable gas chromatograph. Groundwater samples were analyzed by HLI for the parameters shown in Table 2 using Method 8021. Detection limits for groundwater screening analyses were 2 ppb for purgeable aromatics and 1 ppb for purgeable halocarbons. In addition, to allow evaluation of possible jet fuel contamination, groundwater samples were field screened for TPH using Method OA-2 and a detection limit of 0.5 ppm. Groundwater sample results



for on-site analyses are provided in Appendix H. A summary of contaminants detected in wells sampled by Golder and HLI during the Phase I investigation is provided in Table 3.

For locations where samples for off-site analysis were collected, two 40 ml VOC bottles, preserved with hydrochloric acid (HCl), were filled according to the sampling methodology presented above. Additionally, a one liter (L) amber glass container was filled for OA-2 TPH analysis.

Duplicate groundwater samples collected for off-site analysis were sent to the Pace laboratory and were subject to the methodologies stated above. Throughout duplicate sample collection and shipment strict chain-of-custody (COC) procedures were followed. Groundwater sample results for off-site analyses are provided in Appendix I.

#### 3.3.4 KDHE Monitor Wells

Groundwater screening samples were collected from KDHE monitor wells M1, M3, and M4 during the December 1997 Phase I investigation. The monitor wells are located within the MARCO property boundary (Figure 5). The wells were purged and sampled by Golder and HLI personnel. Purge and sample activities were accomplished using a Whale™ submersible 12 volt pump.

Static water levels were measured prior to sampling and casing volumes were calculated. A minimum of three casing volumes were removed during purge activities and field parameters of pH, temperature, and conductivity were recorded approximately every 1/2 casing volume. Stabilization of these parameters generally indicates that purging is complete and formation water is being removed. Parameter stabilization was defined as less than a  $\pm 10$  percent change during three consecutive readings.





The KDHE monitor well samples were collected and analyzed according to the protocol discussed previously. Monitor well purge and parameter information is summarized on Golder's well development data sheets provided in Appendix G. Groundwater sample results for on-site analyses are provided in Appendix H. A summary of contaminants detected in wells sampled by Golder and HLI during the Phase I investigation is provided in Table 3.

The submersible pump and sampling equipment was thoroughly decontaminated between sample points using previously discussed methods. New latex gloves were worn by personnel throughout sampling activities.



## 4.0 REGIONAL CONDITIONS

Subsurface conditions in Neosho County have been described by the Kansas Geological Survey (Jungmann 1966). Except as otherwise noted, the following regional subsurface descriptions are attributed to this Kansas Geological Survey publication.

### 4.1 Geology

#### 4.1.1 Bedrock Units

The Chanute area is underlain by bedrock units of the Pennsylvanian System, Missourian Stage, Kansas City Group. In order of increasing depth, these bedrock units include the Chanute Shale, Drum Limestone, and Bonner Springs Shale. These strata regionally dip to the northwest at approximately 20 feet per mile, although bedrock dips locally range from zero to 40 feet per mile.

In Neosho County, the Chanute Shale is comprised of two sandstone members and an intervening shale member. Drill holes located west and southwest of the City of Chanute indicate that the entire Chanute bedrock unit ranges in thickness from 30 to 110 feet. Individual members of the Chanute bedrock unit are characterized in ascending order as follows.

**Noxie Sandstone Member** - This unit is described as fine to very fine-grained quartzose sandstone that is thin-bedded to medium-bedded, ranges in thickness from 1 to 30 feet, and is most commonly cemented with silt, silica, and iron oxide. Near Chanute, the Noxie Sandstone was apparently deposited in an approximate 4-mile wide channel that is oriented northeast-southwest.

**Unnamed Shale Member** - The upper portion of the Noxie Sandstone grades into an unnamed shale unit that is as much as 7 feet thick southwest of the City of Chanute, although this shale unit is not continuous in western



Neosho County. This shale unit is characterized as light grayish-green clay shale that is slightly silty in the upper 2 feet. The Thayer Coal, which is typically 0.4 to 2 feet thick, is often present at the top of the unnamed shale unit.

**Cottage Grove Sandstone Member** - Except for the Cottage Grove Sandstone being thicker-bedded than the Noxie Sandstone, these units are nearly indistinguishable. Where weathered, these sandstone strata are yellowish-orange to deep brownish-red, and are very light gray where unweathered.

#### 4.1.2 Alluvium

The Neosho River Valley is characterized by alluvial deposits of Pleistocene and Recent ages, although the Recent alluvium is typically confined to the active stream channel. Geologic mapping performed by the Kansas Geological Survey indicates that the Pleistocene alluvial unit ranges in thickness from 18 to 40 feet, and averages approximately 25 feet in Neosho County. Pleistocene alluvium is characterized as silt and fine to coarse sand. Coarse chert pebbles are commonly present in an approximate 3-foot thick zone at the base of the alluvial deposits (Jungmann 1966).

#### 4.2 Hydrogeology

Groundwater in Neosho county is present under both confined and unconfined conditions. Alluvium and weathered bedrock in the Chanute area are generally characterized by unconfined groundwater conditions, while wells constructed in the unweathered bedrock of Neosho County typically encounter confined groundwater conditions (Jungmann 1966).

The major source of groundwater recharge to weathered bedrock aquifers located in the upland areas of Neosho County is local precipitation, particularly during the spring months. Recharge and discharge relationships of the Neosho River, adjacent unconsolidated units, and underlying bedrock units are not well defined in Neosho County.



The most productive bedrock aquifers in Neosho County are the sandstone members of the Chanute Shale. In the western portion of the County, wells completed in the Noxie and Cottage Grove sandstone members yield 0.5 to 15 gallons per minute (gpm). East of Chanute, these sandstone units reportedly yield up to 4 gpm. Wells installed in the Pleistocene alluvium in Neosho County yield 3 to 8 gpm (Jungmann 1966).

#### **4.3 Groundwater Quality**

Groundwater in Neosho County is commonly highly mineralized, particularly in the limestone and shale aquifers. Groundwater in the sandstone and alluvial aquifers is generally softer and of better quality (Jungmann 1966).

#### **4.4 Nearby Water Wells**

The previous MARCO investigation concluded that there were no known domestic wells within 1 mile downgradient from the site (KDHE 1987). Therefore, it was concluded that there was no immediate threat to private drinking water supplies. As previously noted, the City of Chanute's municipal water supply is obtained from the Neosho River.

Review of current KDHE water well records indicates that there are no registered wells in the downgradient area of concern. Based on the current understanding of site vicinity groundwater flow conditions, the downgradient area of concern extends eastward from the MARCO site towards the Neosho River. As shown on Figure 4, registered wells are not present in this downgradient area. Although several wells are located approximately 1 mile south of the site, and a total of two wells are located about 1/2 mile west and northwest of the site, these wells are not situated in potential impact areas. As previously noted, Fairway Crude and Ash Grove Cement wells were located near the MARCO site (Figure 4), but no longer exist. Therefore, currently available data support the previous KDHE





conclusion that the MARCO site does not pose an immediate threat to private drinking water supplies.



## 5.0 SITE-VICINITY CONDITIONS

### 5.1 Geology

#### Previous Investigative Results

Drilling performed at the site in 1986 by KDHE resulted in four boreholes that fully penetrated the alluvial units, as shown on the borehole logs and geologic cross sections presented in Appendix A. Based on the KDHE borehole logs, unconsolidated units at the MARCO site are characterized in descending order as follows.

- ▶ 1 to 3 feet of top soil and/or fill
- ▶ 2 to 9 feet of brown to black clay
- ▶ 5 to 13 feet of brown to black silty, sandy clay to silt
- ▶ 6 to 8 feet of brown to reddish brown sand to silt
- ▶ 2 feet of coarse sand with chert pebbles

A generalized description of alluvial and uppermost bedrock units at the MARCO site is (in descending order) as follows (adapted from KDHE 1987).

**Silty Clay** - This unit was 7 feet thick at well M4 and 22 feet thick at well M3, indicating that this unit increases in thickness towards the east. The upper portion of this unit was characterized as moderately low permeability, brown to black clay. The sand, silt, and moisture content of this unit increased with depth.

**Sand/Sandstone** - A total of 3 to 10 feet of wet sand or sandstone was encountered in the KDHE borings. This relatively high permeability unit was encountered at depths ranging from 9 feet at M4 to 23 feet at M3, and included 1 to 4 feet of sandstone at wells M3 and M4 (apparently the



Cottage Grove Sandstone Member). In wells M1 through M3, this unit included 2 feet of coarse sand and chert pebbles directly overlying shale.

**Shale** - The KDHE borings encountered shale at depths ranging from 13 feet at well M4 to 26 feet at well M3. This dark gray to bluish-gray shale unit was described by KDHE as tight and dry, and was noted to be the unnamed member of the Chanute Shale.

Subsurface investigations near the current Total Service Station (Geraghty & Miller 1996), which is located near the southeast corner of the MARCO site, encountered different stratigraphy than that in the KDHE borings. The Geraghty & Miller borings typically encountered 1 to 2 feet of top soil underlain by 3 to 4 feet of sand and approximately 9 feet of silty clay.

The Geraghty & Miller investigation included grain size analyses and falling head permeameter testing of two soil samples from borings at the Total Service Station. The sample with 70 percent fines had a hydraulic conductivity of  $8 \times 10^{-6}$  cm/sec, and the sample with 77 percent fines had a hydraulic conductivity of  $7 \times 10^{-8}$  cm/sec.

### **Phase I Investigative Results**

Drilling performed during the December 1997 Phase I investigation resulted in 20 boreholes that fully penetrated unconsolidated materials. "Direct push" core methods were utilized and probe holes were advanced to bedrock refusal. Soil borehole logs are presented in Appendix E. Probe hole and geologic cross-section locations are shown on Figure 7. Geologic cross-sections A-A', B-B', C-C', D-D', and E-E' were constructed using Phase I soil borehole logs and KDHE logs from the 1986 investigation. The cross-sections are presented as Figures 8, 9, 10, 11, and, 12, respectively.



Cross-section A-A' trends southwest/northeast in the upgradient portion of the MARCO site. Unconsolidated material thickness ranges from approximately 2 feet at probe hole P-7, the topographically highest probe location, to over 15 feet at probe hole P-10.

Cross-sections B-B' and C-C' trend southwest/northeast and northwest/southeast, respectively. B-B' and C-C' provide section views of the areas immediately north and south of the MARCO site, as well as the area immediately downgradient of the property, where the cross-sections intersect. Unconsolidated material thicknesses along cross-section B-B' range from approximately 2 feet at probe hole P-6 to 25 feet at P-17. Unconsolidated material thicknesses along C-C' are less variable, ranging from approximately 15 feet at P-10 to about 24 feet at P-14.

Cross-sections D-D' and E-E' trend north to south and are located in the relatively flat area downgradient from the MARCO site. Unconsolidated material thickness is fairly consistent in this area, although an area of soil thinning is suggested near probe holes P-2 and P-20. Phase I stratigraphic data suggest that unconsolidated materials are thinnest in the topographic high areas located west and south of the MARCO site, and increase in thickness to the east toward the Neosho River.

A generalized description of alluvial and the uppermost bedrock units within the investigative area surrounding the MARCO property (in descending order) is as follows.

**Topsoil/Fill** - Topsoil thicknesses typically ranged from 1 to 3 feet in the vicinity of the site-perimeter probe holes. Topsoil was typically characterized as a yellowish-brown clayey silt with varying amounts of sand and organic material. Probe holes P-12, P-14, P-15, P-16 and P-20 were located in areas of significant historic infilling. Fill depths in these areas ranged from approximately 5 feet at P-15 to greater than 15 feet at P-14. Fill material at P-12 was predominantly kiln dust waste from the Ash Grove Cement Plant. The remaining locations contained varying amounts of fill soil, gravel, organic material and scrap metal.





**Silty Sand/Clayey Sand** - Within the investigative area this unit is limited to the area near the southeast corner of the MARCO property boundary. Thicknesses ranged from approximately 3 to 4 feet in wells MW-1 through MW-8, to approximately 1.5 feet at probe hole P-4. This unit was not found at KDHE monitor well M1, nor in probe holes P-3, P-5, P-14, P-15 and P-16. Although this unit is most commonly characterized as a silty sand (SM based on the USCS, as described on Figure E-1 of Appendix E), zones of clayey sand (SC) are locally present.

**Silty Clay** - This is the predominant unconsolidated unit at the investigative site, although it is not observed at upgradient probe holes P-7, P-8, and P-9. This unit increases in thickness towards the east, with a thickness of approximately 20 feet at P-1 and P-19. The upper portion of the unit is typically black to brown becoming light gray to light brown at depth. The sand and silt content of this unit increased with depth. This unit is characterized as low plasticity clay (CL), although some zones of moderate plasticity clay (CL-CH) are present. Based on qualitative characterization, this unit is characterized by moderate to low permeability.

**Sand and Chert Gravel** - This sand to sandy gravel unit was encountered in nearly all downgradient probe holes, and ranged in thickness from approximately 0.5 feet to 2 feet. This relatively high permeability sand unit was observed at depths ranging from approximately 2 feet bgs at P-6 to greater than 22 feet bgs at P-14. In probe holes P-1, P-2, P-3, P-4, P-13, P-14, P-15, and P-20 this unit included up to 1 foot of a sandy chert gravel. The upper portion of this granular unit is characterized as a silty sand (SM) or a clayey sand (SC), while the lower portion of this unit is commonly a silty gravel (GM) or a clayey gravel (GC).

**Sandstone** - Investigative probe holes were typically terminated at refusal within the Cottage Grove Sandstone Member. This relatively high permeability sandstone unit is characterized as a highly weathered, dark yellowish orange, fine to medium grained, very weak sandstone. Depth to the sandstone bedrock contact ranged from 1.5 feet bgs at probe hole P-9 to greater than 24 feet bgs at P-14.

**Shale** - The shale unit observed in the KDHE 1986 monitor well borings was only encountered at probe hole P-15 during Phase I investigative activities. This unit was characterized as a highly weathered, thinly laminated, medium dark gray, very weak shale. The shale was observed at a depth of 23 feet bgs, just below the sandstone unit. The shale unit is assumed to be the unnamed member of the Chanute Shale.



A structural contour map of the bedrock surface in the vicinity of the MARCO site is presented as Figure 13. Beneath the MARCO property, the bedrock surface slopes to the northeast at approximately 0.05 feet per foot (ft/ft), while immediately east of the MARCO property, the bedrock surface generally slopes to the east at about 0.01 ft/ft. The Phase I investigations indicate that elevation of the bedrock surface ranges from 954.2 feet (NGVD) at probe hole P-7 to 889.5 feet (NGVD) at P-18. As illustrated by Figure 13, a bedrock high trending roughly northwest/southeast is present in the vicinity of probe holes P-2, P-20, and P-19.

## 5.2 Hydrogeology

### Previous Investigative Results

Based on previous investigations at the MARCO site (KDHE 1987), groundwater at the site occurs within the silty clay unit and the lower sand/upper sandstone unit described in Section 5.1. Although groundwater was encountered in both of these units, previous data indicate that the sand/sandstone hydrostratigraphic unit is the uppermost aquifer in the site vicinity because of the higher transmissivity of this unit relative to the overlying silty clay unit.

In November 1986 and January 1987, groundwater flow within the uppermost aquifer was to the east-southeast at an average horizontal hydraulic gradient of 0.025 ft/ft. Static water levels in the KDHE wells ranged from approximately 3.5 feet to 5.7 feet below ground surface (bgs) in 1986 and 1987. The shale stratum that was encountered below the alluvium was assumed by KDHE to be a low permeability confining unit.

Water level monitoring near the Total Service Station by Geraghty & Miller (1996) and Terracon (1997a and 1997b) suggests that groundwater flow was in a general easterly



direction at an average horizontal hydraulic gradient of 0.02 to 0.025 ft/ft, which is consistent with the KDHE data. Static water levels typically ranged from 1.5 to 4 feet bgs.

Slug withdrawal hydraulic conductivity testing was performed in wells MW-1 and MW-2 at the Total Service Station (Geraghty & Miller 1996). The resulting hydraulic conductivity values ranged from approximately  $2\text{--}3 \times 10^{-5}$  cm/sec.

### **Phase I Investigative Results**

Results of the Phase I investigation support the hydrogeologic model previously developed for the site-vicinity (Golder 1997). Investigations performed to date indicate that the site is typically underlain by the following major hydrostratigraphic units: 1) a silty clay unit that tends to function as an aquitard beneath and downgradient from the MARCO property; and 2) underlying the silty clay unit, a relatively high permeability zone that is generally the uppermost aquifer beneath the site. Although the silty clay aquitard is not present upgradient from the MARCO property, it is approximately 20 feet thick in areas east of the site.

The underlying uppermost aquifer is generally comprised of: 1) the sand and gravel unit that directly underlies the silty clay unit; and 2) the upper portion of the Cottage Grove Sandstone, which is highly weathered and apparently permeable. The combined thickness of the units that comprise the uppermost aquifer beneath the site is estimated to range from 2 to 5 feet. Groundwater within the uppermost aquifer is typically present under semi-confined conditions, as indicated by Figures 8 through 12.

Although laterally discontinuous, the shallow sand unit present near the southeast corner of the MARCO property is potentially an important hydrostratigraphic unit. Where present,



this sand unit typically extends from approximately 1 foot bgs to 4 feet bgs. Based on current data, groundwater within this unit is typically present under unconfined conditions.

Phase I data indicate that groundwater levels in mini-wells constructed near the MARCO facility typically range from near ground surface to about 7.5 feet bgs. On average, the groundwater level is 2 to 3 feet bgs in the vicinity of the Phase I mini-wells. The primary exception is P-18, which is located in the marshy area east of the site. The December 1997 water level measured in P-18 indicated slight artesian conditions. With the exception of P-18, which was considered anomalous, water level data obtained from Phase I investigative mini-wells and previous KDHE monitor wells were used to develop the potentiometric surface map provided as Figure 14. This figure illustrates potentiometric conditions within the uppermost aquifer, which is comprised of the unconsolidated sand and gravel unit and the underlying highly weathered sandstone.

During December of 1997, groundwater flow within the uppermost aquifer was generally to the east, although a slight flow component to the east-northeast toward Village Creek was evident. Based on December 14, 1997 data, the horizontal hydraulic gradient was significantly greater beneath the MARCO property relative to downgradient areas. For example, the horizontal hydraulic gradient was approximately 0.03 feet/foot (ft/ft) between the western and eastern boundaries of the MARCO property, and approximately 0.002 ft/ft from the eastern property boundary to P-19. The average horizontal hydraulic gradient between mini-wells P-7 and P-19 was 0.02 ft/ft, which is equivalent to the slope of the bedrock surface between P-7 and P-19, suggesting that the groundwater flow regime within the uppermost aquifer is significantly influenced by bedrock topography. However, it should be noted that the Phase I water level data may not be indicative of seasonably variable potentiometric conditions.





## **5.3 Contaminant Characterization**

### **5.3.1 Soil Contamination**

#### **Previous Investigative Results**

As part of the 1986 KDHE investigation, two soil samples (MAS1 and M2), a sediment sample (MASD), and a sludge sample (MAS3) were collected from the approximate locations shown on Figure 2. Results of this sampling program are included in Appendix A. The 1987 report by KDHE concluded that soil contamination is present throughout the site.

#### **Phase I Investigative Results**

Soil samples were analyzed at 20 probe hole locations during Phase I investigative activities. The samples were collected from soil core material during direct push probing activities described in Section 3.2. Soil samples were analyzed for the parameters shown in Table 2. On-site soil screening analysis was conducted by HLI; these analytical results are provided in Appendix H. QA/QC duplicate analysis was conducted by Pace Analytical, with results provided in Appendix I. Contaminants detected during Phase I activities are summarized in Table 3.

TPH and BTEX compounds were the primary contaminants detected in soil samples downgradient of the MARCO facility. As illustrated by Figure 15, TPH contaminants were encountered in soils at P-3 (1.41 ppm), P-19 (4.67 ppm), P-2 (45.9 ppm), P-4 (163 ppm), and P-20 (243 ppm), based on samples taken directly above the water table. Isoconcentration contours provided on Figure 15 suggest that off-site TPH migration extends into the low-lying area directly downgradient of the MARCO site.



During soil coring activities, petroleum compounds were visible throughout P-2 and P-4 core, although localized non-contaminated areas were evident as well. Contamination within P-20 soil core was visible from approximately 5 feet to 13 feet bgs. Contamination was visually identified by the "sheen" typical of petroleum products. PID readings and core odor were also used to determine zones of contamination. No visible contamination or odor was observed within soil core at probe holes P-3 and P-19.

The soil TPH contaminant plume trace depicted on Figure 15 extends downgradient of the site within a low-lying area that drains into wetlands to the east. The pathway seems to coincide with the historic MARCO facility railroad spur. Furthermore, the TPH plume trace mirrors the structural bedrock high suggested on Figure 13, indicating that some type of structural control, natural or man-made, could have influences TPH migration from the MARCO facility. Historic soil TPH contaminant levels recorded during installation of monitor wells MW-1 through MW-8 (Geraghty and Miller, 1996) were not included in the construction of Figure 15, since they likely are partially indicative of contamination from Total Service Station.

Soil BTEX concentrations are provided on Figure 16. Total BTEX soil concentrations were measured in probe holes P-2 and P-4 at 102.3 ppb and 3987 ppb, respectively. Elevated soil BTEX concentrations downgradient from the MARCO facility are seemingly confined to the area near Santa Fe Avenue. However, soil field screening performed during installation of monitor wells MW-1 through MW-8 yielded significant benzene concentrations of up to 11,000 ppb (Geraghty and Miller 1996).

In addition to the TPH and BTEX compounds detected, elevated concentrations of naphthalene were detected at probe holes P-2 (495 ppb) and P-4 (6170 ppb) within screening samples (Table 3). A QA/QC duplicate sample at probe hole P-14 yielded a naphthalene concentration of 130 ppb, although the screening sample for that location was



characterized as non-detect. The soil sample at probe hole P-7 yielded a chloroform concentration of 6.7 ppb.

Pace duplicate samples taken at probe holes P-7, P-14, and P-18 yielded chloromethane concentrations of 440 ppb, 420 ppb, and 400 ppb, respectively. A chloromethane concentration of 530 ppb was detected in the Pace method blank, indicating that the contaminant was lab induced.

### 5.3.2 Groundwater Contamination

#### **Previous Investigative Results**

As part of the 1986 KDHE investigation of the MARCO site, seven site vicinity wells were sampled, including four wells installed by KDHE (M1 through M4). Groundwater sampling locations are shown on Figure 2. Results of this sampling program, which are included in Appendix A, are summarized below.

**Well M1** - This well, which is located near the eastern (downgradient) boundary of the MARCO site, indicated the most significant groundwater contamination at the site. Groundwater sampling of well M1 was initially performed on November 6, 1986, resulting in a total VOC concentration of 219.9 parts per billion (ppb). Because of the relatively high contaminant concentrations measured in the initial sample, well M1 was resampled on January 29, 1987, resulting in a total VOC concentration of 563.2 ppb. BTEX concentrations in the second sample were 520.0 ppb benzene, 11.7 ppb toluene, 1.0 ppb ethylbenzene, and 29.0 ppb total xylene. Other notable detection's in the second sample include phenol at 10.2 ppb, 2-methyl-naphthalene at 15.5 ppb, and bis (2-ethylhexyl) phthalate at 28.1 ppb. It is reported that M1 was also sampled in 1990, resulting in 1000 ppb benzene, 40.8 ppb toluene, 62.5 ppb ethylbenzene, and 16.4 ppb total xylene (Geraghty & Miller 1996).

**Well M2** - This well was installed immediately east of the site (downgradient), although this well no longer exists. VOCs were not



detected in the M2 sample, although di-n-octyl phthalate was measured at 29.5 ppb and phenol was measured at 3.0 ppb.

**Well M3** - This well is located near the northeast corner of the site. VOCs were not detected in the M3 sample, although di-n-octyl phthalate was measured at 96.3 ppb and bis (2-ethylhexyl) phthalate was measured at 12.9 ppb.

**Well M4** - This well is located immediately east of the BS Pit. VOCs were not detected in the M4 sample, although di-n-octyl phthalate was measured at 135 ppb.

**Larkin Well** - This upgradient well is located west of the site (Figure 3). No priority pollutants were measured in this well, which is 101 feet deep.

**Ash Grove Well** - This 22-foot deep well, which was located between the MARCO site and Village Creek, no longer exists. VOCs were not detected in this well, although di-n-octyl phthalate was measured at 175 ppb.

**Fairway Crude (FC) Well** - This 12.7-foot deep well, which was located near the northwest corner of the MARCO site, apparently no longer exists. The only priority pollutant measured in this well was benzene at 0.9 ppb.

It was concluded that groundwater contamination had occurred beneath the MARCO facility, and that the contaminated groundwater plume was migrating to the east-southeast (KDHE 1987). The contaminated groundwater plume included refined petroleum products (BTEX compounds) and was apparently located above the unnamed member of the Chanute Shale.

Supplemental groundwater sampling of wells M1, M3, and M4 was performed by KDHE on May 2, 1996. As noted in Appendix B-2, grab samples were collected for analysis of priority pollutant VOCs. BTEX concentrations in the M1 sample were 296 ppb benzene, 31.3 ppb toluene, and 21.0 ppb total xylene. VOCs were not detected in the M3 and M4 samples.





Pertinent groundwater quality data are also available (Geraghty & Miller 1996) from monitor wells installed near the current Total Service Station located near the southeast corner of the MARCO site (Figure 2). September 1995 BTEX concentrations in these wells included 4,490 ppb at MW-7, 36.6 ppb at MW-2, 22.7 ppb at MW-6, and 7.9 ppb at MW-3. BTEX concentrations were not detected in the other wells sampled. Groundwater sampling of these same wells in July 1997 resulted in BTEX concentrations of 2,700 ppb at MW-7, 37 ppb at MW-6, 13 ppb at MW-3, and 1 ppb at MW-1 (Terracon 1997a). Groundwater sampling of these wells in September 1997 (Appendix B-1) resulted in BTEX concentrations of 3,980 ppb at MW-7, 27 ppb at MW-6, 59 ppb at MW-3, and 1 ppb at MW-1 and MW-8 (Terracon 1997b). The 1997 sampling events suggest that BTEX concentrations measured in these wells are likely attributable to the MARCO site, since BTEX concentrations were noted upgradient from the Total Service Station and downgradient from the MARCO site.

### **Phase I Investigative Results**

Groundwater samples were analyzed at 20 probe hole locations during Phase I investigative activities. The samples were collected from groundwater following direct push coring activities using the methodology described in Section 3.2. Groundwater samples were analyzed for the parameters shown in Table 2. On-site groundwater screening analysis was conducted by HLI; these analytical results are provided in Appendix H. QA/QC duplicate analysis was conducted by Pace Analytical, with results provided in Appendix I. Contaminants detected during Phase I activities are summarized in Table 3. Results of Phase I groundwater sampling activities are described below.

**P-4** - This downgradient mini-well, located near the southeast corner of the MARCO property, yielded the most significant off-site groundwater contamination. The December 1997 groundwater screening sample for this well resulted in BTEX concentrations of 645 ppb benzene, 367 ppb toluene,



148 ppb ethylbenzene, and 150 ppm total xylene. Other notable detections included naphthalene at 202 ppb and TPH at 1.73 ppm.

**P-2** - This mini-well was installed immediately downgradient of the MARCO site and approximately 450 feet north of P-4. The groundwater screening sample for this well resulted in BTEX concentrations of 16.8 ppb benzene, 9.08 ppb toluene, and 7.24 ppb ethylbenzene. Other notable detections included naphthalene at 18.9 ppb, 1,2-dichloroethane at 4.85 ppb, and TPH at 0.55 ppm. A QA/QC duplicate sample was collected from P-2 for off-site analysis. The duplicate sample did not report detections of naphthalene or TPH. Additionally, chlorobenzene and 1,2-dichlorobenzene were detected in the duplicate sample at 2.5 ppm and 2.6 ppm, respectively.

**P-20** - This probe hole was located downgradient of the site approximately 170 feet east of abandoned KDHE monitor well M2. The groundwater screening sample for this probe hole resulted in a TPH concentration of 1.68 ppm. A QA/QC duplicate sample collected from P-20 yielded VOC concentrations of chlorobenzene (0.71 ppb), 1,2-dichlorobenzene (2.2 ppb), and 1,4-dichlorobenzene (1.1 ppb).

**M1** - This KDHE monitor well, which is located on the MARCO property near the eastern boundary, has historically contained the most significant groundwater contamination on the MARCO site. The December 1997 groundwater screening sample for this well resulted in BTEX concentrations of 372 ppb benzene and 19.6 ppb toluene. Groundwater screening for KDHE monitor wells M3 and M4 resulted in no detections for the constituents listed in Table 2.

**P-5** - This probe hole was located south of the MARCO site and approximately 150 feet west of Terracon well MW-3. The groundwater screening sample for this probe hole resulted in BTEX concentrations of 12 ppb benzene, 15.1 ppb toluene, and 2.18 ppb ethylbenzene.

**P-7** - This mini-well was installed upgradient of the MARCO property and south of the EOTT building. Groundwater screening and duplicate samples for this well resulted in detected chloroform concentrations of 3.2 ppb and 1.4 ppb, respectively.

**P-9** - This mini-well was installed upgradient of the MARCO site near the northwest corner of the property. The groundwater screening sample for this well resulted in a chloroform concentration of 1.2 ppb.

**P-11** - This probe hole was located north of the MARCO site on Ash Grove Cement Company property. The groundwater screening sample for this probe hole resulted in a TPH concentration of 0.56 ppm.



**P-12** - This mini-well is located northeast of the intersection of Santa Fe Avenue and Ash Grove Road, near the Ash Grove Cement Company railroad spur. The groundwater screening sample for this well resulted in a detected chloroform concentration of 4 ppb.

No other contaminants were detected in Phase I groundwater samples.

Site-vicinity groundwater TPH concentrations are presented on Figure 17. TPH compounds were detected at probe holes P-2 (0.55 ppm), P-4 (1.73 ppm), P-11 (0.56 ppm), P-20 (1.68 ppm), and KDHE monitoring well M1 (0.39 ppm). Groundwater TPH isoconcentration contours delineate an area similar to the soil TPH isoconcentration map (Figure 15). Groundwater TPH concentration contours also suggest that contamination extends north of the MARCO property in the vicinity of probe hole P-11. This northern extension of TPH contaminants could be attributed to a northeast trending groundwater flow component from the MARCO site.

BTEX compounds are the major groundwater contaminants detected during the Phase I investigation. Phase I probe hole groundwater quality data were combined with available data from monitor wells MW-1 through MW-8 (Terracon 1997a and 1997b) installed near the current Total Service Station located near the southeast corner of the MARCO site.

Groundwater total BTEX isoconcentration contours are provided on Figure 18. Terracon monitor well water quality data collected September 9, 1997 included BTEX concentrations of 3980 ppb at MW-7, 59 ppb at MW-3, 27 ppb at MW-6, 1 ppb at MW-2, and 1 ppb at MW-8. Phase I investigative probe hole locations yielded BTEX concentrations of 1310 ppb at P-4, 33.1 ppb at P-2, 29.3 ppb at P-5, and 391.6 ppb at KDHE monitor well M1.

Figure 18 suggests that BTEX contaminants are mainly confined to the southeast corner of the site. BTEX contaminants detected at probe holes P-5 and P-4, which are upgradient



and cross-gradient from the Total Service Station, support the results of previous sampling events suggesting that the noted BTEX contamination originates from the MARCO site. Groundwater isoconcentration maps for individual BTEX compounds benzene, toluene, ethylbenzene, and total xylene are presented as Figures 19, 20, 21, and 22, respectively. These isoconcentration maps suggest groundwater contamination occurrence and conclusions similar to those noted for BTEX.

Groundwater naphthalene isoconcentration contours are provided on Figure 23. Terracon monitor well water quality data collected September 9, 1997 included naphthalene concentrations of 320 ppb at MW-7, 6.6 ppb at MW-3, and 1.6 ppb at MW-6. Phase I investigative probe hole locations yielded naphthalene concentrations of 202 ppb at P-4 and 18.9 ppb at P-2 although, the Pace duplicate sample at P-2 was non-detect for naphthalene. In addition, while the groundwater screening sample at P-14 was non-detect for naphthalene, the Pace duplicate sample for P-14 resulted in a naphthalene concentration of 130 ppb.

Naphthalene isoconcentration contours indicate that this contaminant is confined to the southeast corner of the site, similar to BTEX compounds. The detection of naphthalene in the P-14 duplicate sample (130 ppb) however, suggests that the contaminant possibly extends beyond the downgradient migration of other aromatic VOCs.

Although Phase I groundwater screening samples yielded no detections of MTBE, Terracon monitor well water quality data collected September 9, 1997 included MTBE concentrations of 15 ppb at MW-2, and 1.4 ppb at MW-5. These MTBE detections are attributed to the Total Service Station since MTBE was not used as a gasoline additive until after MARCO operations were discontinued.





Other contaminants detected in Phase I groundwater samples include chloroform and 1,2-dichlorobenzene. Groundwater screening samples resulted in chloroform concentrations of 3.2 ppb at P-7, 1.2 ppb at P-9, and 4.0 ppb at P-12. The remaining sample points were non-detect. 1,2-dichlorobenzene was detected in Pace duplicate samples yielding concentrations of 2.6 ppb at P-2 and 1.1 ppb at P-20. Groundwater screening samples for P-2 and P-20 were non-detect for the 1,2-dichlorobenzene.



## 6.0 CONCLUSIONS

Phase I of a Comprehensive Investigation of off-site soil and groundwater contamination was conducted near the MARCO site in Chanute, Kansas during December of 1997. Since the U.S. EPA is responsible for investigation of contamination at the MARCO property, the focus of the Phase I investigation was characterization of off-site contamination. Based on results of the surface water sampling performed by KDHE in 1986 and the groundwater emphasis for the MARCO CI, surface water quality sampling was not performed as part of the Phase I investigation. Major findings of Phase I investigations performed in the vicinity of the MARCO site are as follows.

### Hydrogeologic Model

1. The most significant laterally extensive hydrostratigraphic units in the site-vicinity are a silty clay stratum, the underlying sand and gravel unit, and the Cottage Grove Sandstone Member of the Chanute Shale.
2. Although not present at the upgradient probe hole locations to the west of the MARCO facility, the silty clay unit is approximately 20 feet thick in the eastern portion of the study area. This relatively low permeability silty clay unit tends to function as an aquitard beneath and downgradient from the MARCO property.
3. Underlying the silty clay aquitard is a relatively high permeability zone primarily comprised of sand and cherty gravel. This sand and gravel unit was generally about 0.5 to 2 feet thick where penetrated by Phase I boreholes. The upper portion of this granular unit is characterized as a silty sand or a clayey sand, while the lower portion of the unit is commonly a silty gravel or a clayey gravel. Groundwater within the sand and gravel is typically present under semi-confined conditions; potentiometric levels in the vicinity of the Phase I mini-wells were typically 2 to 3 feet bgs.
4. Phase I investigative probe holes were typically terminated at refusal within the Cottage Grove Sandstone. Bedrock intervals penetrated during Phase I are characterized as highly weathered, fine to medium grained, very weak sandstone. The upper portion of this sandstone unit



is inferred to be relatively permeable. Shale was only encountered in one of the Phase I probe holes. Beneath the MARCO site, the bedrock surface slopes to northeast at approximately 0.05 ft/ft, and slopes to the east at 0.01 ft/ft in the area east of the site.

5. In addition to the major hydrostratigraphic units that are laterally extensive in the site-vicinity, a surficial sand was encountered near the southeast corner of the MARCO property. Where present, this silty to clayey sand unit typically extends from approximately 1 to 4 feet bgs. Groundwater within this surficial sand is generally present under unconfined conditions.
6. The uppermost aquifer that is laterally continuous in the site-vicinity is the relatively high permeability unit that is comprised of the sand and gravel stratum and the upper portion of the Cottage Grove Sandstone. The combined thickness of the uppermost aquifer beneath the site is estimated to range from 2 to 5 feet. Groundwater within the uppermost aquifer is typically present under semi-confined conditions.

### Groundwater Flow Regime

7. Consistent with previous results, December 1997 potentiometric monitoring indicates that groundwater flow within the uppermost aquifer was generally to the east, although a flow component to the east-northeast was also suggested. Seasonal influences may result in variations in the groundwater flow direction.
8. The horizontal hydraulic gradient beneath the MARCO property was about 0.03 ft/ft, but was considerably less (0.002 ft/ft) east of the site. The overall horizontal hydraulic gradient across the study area was 0.02 ft/ft, which is equivalent of the slope of the bedrock surface, suggesting that the groundwater flow regime within the uppermost aquifer is significantly influence by bedrock topography.
9. Depth-discrete potentiometric data have not been collected to date, so conclusions can not be made concerning vertical directions and gradients between the various hydrostratigraphic units.



## Extent of Soil Contamination

10. Previous investigations by KDHE concluded that soil contamination was present throughout the MARCO property. The most significant contaminants encountered off-site from the MARCO property during the Phase I investigations were TPH, BTEX compounds, and naphthalene.
11. A TPH concentration of 243 ppm was detected in probe hole P-20, located approximately 200 feet east of Santa Fe Avenue. Petroleum contamination within the P-20 soil cores was visible between depths of 5 to 13 feet bgs. In addition, a TPH value of 5 ppm was measured approximately 800 feet east of Santa Fe Avenue. TPH soil contamination coincides with the historic MARCO facility railroad spur, which could have provided a high permeability pathway for migration of petroleum compounds. The noted TPH soil contamination also correlates with a structural high in the bedrock surface, although the effect of this geologic feature is not known.
12. Total BTEX concentrations of up to 3,987 ppb (probe hole P-4) were measured in soil samples collected immediately downgradient from the MARCO site. High concentrations of naphthalene were similarly restricted to soil sampling areas located immediately east of Santa Fe Avenue, with a maximum value of 6,170 ppb at probe hole P-4.

## Extent of Groundwater Contamination

13. Previous investigations by KDHE concluded that groundwater contamination had occurred beneath the MARCO facility, and that the contaminated groundwater plume was generally migrating to the east-southeast. In addition, investigations in the vicinity of the Total Service Station concluded that BTEX concentrations measured in monitor wells located near the southeast corner of the MARCO site were likely attributable to groundwater contamination migrating from the MARCO facility. Finally, a landowner located immediately east of the MARCO property reported that several excavations located east of Santa Fe Avenue resulted in observation of contaminated groundwater within approximately 6 feet of the ground surface. Results of the Phase I investigation are generally consistent with these observations and conclusions.





14. Off-site groundwater contamination identified downgradient of the MARCO facility primarily consisted of TPH, BTEX compounds, and naphthalene. Additionally, minor detections of chloroform, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and 1,2-dichloroethane were observed downgradient of the site.
15. TPH contaminated groundwater extended approximately 500 feet downgradient of the MARCO site boundary. The groundwater TPH plume mirrors the soil TPH contamination. Groundwater TPH concentrations ranged from 0.55 ppm at P-2 to 1.73 ppm at P-4. Furthermore, TPH contamination extends north of the site where groundwater concentrations of 0.56 ppm were detected at P-11.
16. Groundwater BTEX contamination is confined to an area immediately downgradient of the site near the southeast corner of the MARCO facility. Total BTEX concentrations ranged from 33.1 ppb at P-2 to 1310 ppb at P-4.
17. Naphthalene contamination is apparently also confined to the southeast corner of the MARCO site. Groundwater concentrations ranged from 18.9 ppb at P-2 to 202 ppb at P-4. A duplicate sample detection of 130 ppb at P-14 suggests that naphthalene is present at a high concentration at a distance of over 400 feet east of Santa Fe Avenue.
18. Groundwater monitoring at P-18 and P-19 indicates that residual impacts from the 1989 hazardous chemical spill are not apparent.
19. Buried utilities in the vicinity of the MARCO facility may have provided a pathway for migration of groundwater contaminants, however available data are not sufficient to support a definitive conclusion.
20. Domestic water well users are not located in the area of contamination downgradient from the MARCO property. Current data support the conclusion that the MARCO site does not pose an immediate threat to private drinking water supplies. Although the City of Chanute's municipal water supply is located downgradient from the site, the MARCO groundwater plume apparently does not extend within 1 mile of the water supply intake.



## **7.0 CORRECTIVE ACTION ALTERNATIVES**

Data collected from the historical evaluation and the Phase I investigation suggest that the following corrective action alternatives should be evaluated during the Corrective Action Study. Items that merit consideration in connection with the potential corrective action alternatives are also noted.

### **Alternative #1 - No Further Action**

Since the U.S. EPA is responsible for investigation and remediation of contamination within the boundaries of the MARCO property, contaminant source areas within the facility have not been evaluated as part of this investigation. Corrective action measures that are ultimately implemented by the U.S. EPA to address contamination within the MARCO facility may eventually remove or mitigate the source areas that are contributing to off-site contamination. This possible scenario could make no further action by KDHE a reasonable alternative.

### **Alternative #2 - Remediation of Uppermost Aquifer**

Remediation of the uppermost aquifer would focus on the upper, highly weathered sandstone unit and the sand and gravel unit that directly overlies bedrock at the site. Contaminants of most significant concern would include VOCs such as benzene and naphthalene, which are present in off-site groundwater in concentrations above the MCLs. Remediation of the uppermost aquifer could also involve petroleum hydrocarbons that are present in downgradient areas. As described below, remedial technologies implemented could include: 1) bioremediation technologies such as ORC injection, SORC wells, biosparging, and biochemical enhancement; 2) construction of treatment walls; or 3) groundwater extraction and treatment.



### **Alternative #3 - Remediation of Uppermost Aquifer and Surficial Sand**

The surficial sand present near the southeast corner of the MARCO facility is apparently not laterally extensive, yet could serve as a significant ongoing source of off-site contamination. Withdrawal of contaminated groundwater from the uppermost aquifer would induce relatively steep downward vertical gradients from the surficial sand to the uppermost aquifer. Depending on the integrity of the intervening silty clay aquitard, the effectiveness of remedial activities in the uppermost aquifer could be compromised by migration of contaminants from the overlying surficial sand. Therefore, the Corrective Action Study should also consider remediation of the surficial sand unit.

Based on current data, the surficial sand unit (where present) typically extends from approximately 1 foot bgs to 4 feet bgs. Because of its shallow occurrence, trenching could be considered in connection with interception and/or remediation of this contaminated flow zone. However, it should be noted that buried utility lines are abundant immediately downgradient from the MARCO facility, thereby making trenching operations problematic. Potential remedial technologies that could be used in connection with the corrective action alternatives described above include the following.

#### **Bioremediation**

**Oxygen Release Compound Injection** - Oxygen Release Compounds (ORC<sup>®</sup>) could be injected into the saturated zone using direct push methods. ORC<sup>®</sup> is a formulation of magnesium peroxide that slowly releases molecular oxygen when hydrated. This oxygen promotes microbial growth and maximizes the ability of aerobic microbes to degrade contaminants such as petroleum hydrocarbons. As the microbes degrade contaminants, carbon dioxide and water remain as reaction products. ORC<sup>®</sup> comes in powder form and typically is mixed into a 30 percent solid slurry for injection purposes and provides enough of the compound to release over an approximate 6-month period. Prior to the introduction of ORC<sup>®</sup>, specific groundwater analytical parameter concentrations should be identified to



determine proper remedial design. Therefore, groundwater sampling and analysis of strategic sample points would be required prior to ORC<sup>x</sup> injection.

**Slow Oxygen Release Compound (SORC) Wells** - Magnesium peroxide or calcium peroxide compounds can be placed into wells, providing similar results to the ORC injection process described above. With the SORC wells, the SORC compounds are placed into "socks," which are linked and lowered into a well. The rate of oxygen release using this material is slow enough that the socks only have to be changed every 6 months to a year.

**Biosparging** - Biosparging is a process that injects air into the aquifer to strip organic compounds from the saturated soils. Injected air then flows to the vadose zone, where a bioventing system is designed to create optimum colonies of bacteria that consume contaminants in the air stream. Air injection results in an increase of the dissolved oxygen content of groundwater, which in turn allows populations of naturally occurring bacteria to multiply and degrade compounds within the aquifer.

**Biochemical Enhancement** - The control of inorganic nutrients is critical to establishing and maintaining the activity of bacteria. Bacteria require both nitrogen and phosphorous to carry out cellular functions. Depending on conditions downgradient from the MARCO facility, it may be necessary to enhance the activity of bioremediation through the addition of nutrients. Phosphate and nitrogen based nutrient feeds can be injected into target zones to stimulate and maintain the remedial process.

### Treatment Walls

Treatment walls or reactive barriers are permeable walls constructed with a treatment material or structure placed across the path of a contaminant plume. The wall can be used to create chemical or biochemical reactions or may facilitate a process that removes the contaminant. They can be installed with trenching where the contaminant is shallow, or by injection through vertical or horizontal wells. Materials which are typically used for these reactive barriers include nutrient compounds, zero valence iron, and activated carbon.





### **Groundwater Extraction and Treatment**

Groundwater can be removed from the ground and treated at the surface utilizing conventional methods of wastewater treatment. Groundwater extraction downgradient from the MARCO site would involve pumping a series of vertical wells to provide the required capture of contaminants. The extracted groundwater would be routed through a conventional treatment system. Several technologies that may be evaluated include air stripping, liquid phase carbon adsorption or ozone destruction. The treated water would then be discharged to a receiving water body, passed to a publicly owned wastewater treatment plant for further treatment and dilution, or reinjected into the ground.

The potential corrective actions described above focus on groundwater remediation instead of remediation of off-site contaminated soils. This groundwater focus is based on the assumption that the most contaminated soils are present within the MARCO facility, and will be addressed through a U.S. EPA corrective action. Focusing on remediation of off-site contaminated groundwater was also driven by the assumption that off-site soil remediation would be relatively costly, and would involve more significant disruption of utilities and the operations of downgradient landowners. These assumptions will be further evaluated as part of the Corrective Action Study.



## 8.0 RECOMMENDATIONS

As described in the MARCO CI Work Plan (Golder 1997), a phased approach was envisioned for investigation of migration of contaminants off-site from the MARCO facility. Based on the results of Phase I, and data gaps that should be filled in support of the Corrective Action Study, we recommend that the following activities be performed as Phase II of the MARCO CI.

1. **Well Installation in the Uppermost Aquifer** - We recommend that two wells be installed in the area of maximum groundwater contamination immediately southeast of the MARCO property. The wells would be screened in the sand and gravel and highly weathered bedrock unit that comprises the laterally continuous uppermost aquifer beneath the site. We recommend that the wells be installed within approximately 100 feet of existing wells P-4 and MW-7. These wells would be 2-inch or 4-inch diameter, depending on hydraulic test considerations and the potential usefulness of these wells as withdrawal or injection points in connection with remediation of the uppermost aquifer. Drilling performed in connection with this well installation will also allow collection of undisturbed samples of the silty clay aquitard, and laboratory testing to determine the vertical hydraulic conductivity of this unit.
2. **Well Installation in the Deeper Bedrock** - We recommend that one deeper well be installed near MW-7, in the area of maximum groundwater contamination. To prevent introduction of a possible pathway for migration of contaminants from the uppermost aquifer to a lower flow zone, the borehole would be sealed through the uppermost aquifer prior to coring approximately 15 feet into relatively competent rock. This deeper monitoring point would allow: 1) characterization of the bedrock interval that could function as an aquitard to downward migration of contaminants; 2) screening and monitoring of the strata present below the highly weathered bedrock; 3) evaluation of the vertical gradient between the uppermost aquifer and the deeper strata; 4) evaluation of the vertical extent of groundwater contamination; and 5) evaluation of the degree of hydraulic connection between the uppermost aquifer and the deeper bedrock, as indicated by the hydraulic testing program described below.



3. **Hydraulic Testing** - Evaluation of corrective action alternatives for the uppermost aquifer will require reasonably accurate estimation of the hydraulic properties of this groundwater flow zone. To fill this data gap, we recommend that pumping tests be performed in the two new uppermost aquifer wells, using existing wells as observation points for determination of representative hydraulic values for the uppermost aquifer. Hydraulic testing of the uppermost aquifer would: 1) allow determination of the rate of migration of the contaminant plume located near the southeast corner of the MARCO site; 2) allow evaluation of the hydraulic interconnection between the uppermost aquifer, the deeper bedrock flow zone, and the surficial sand unit that is present in this portion of the site; and 3) support potential remedial design activities.
4. **Supplemental Probe Holes** - We recommend that supplemental direct push probing be performed downgradient from the MARCO site to allow: 1) further delineation of the lateral and vertical extent of the surficial sand unit noted near P-4 and MW-7; 2) groundwater screening of this surficial groundwater flow zone; 3) installation of temporary mini-wells in this surficial sand to determine the hydraulic response of this flow zone to pumping of the underlying uppermost aquifer; 4) additional characterization of subsurface conditions between the MARCO facility and the railroad bed located downgradient from the site; and 5) collection of data that would support potential remedial design activities for the surficial sand unit.
5. **Groundwater Monitoring** - The conclusions provided herein are largely based on the groundwater monitoring event performed in December 1997. Instead of basing the subsequent corrective action evaluation on a single sampling event, we recommend that Phase II include an additional groundwater monitoring event to allow confirmation of the December 1997 water quality results. Supplemental groundwater sampling would also allow monitoring for parameters such as BOD, COD, dissolved oxygen, nitrate, iron (II), sulfate, sulfide, Eh, pH, total organic carbon, alkalinity, and chloride; information on these parameters would be useful in preliminary evaluation of the correction action alternatives and potential remedial technologies described in Section 7. To allow partial evaluation of seasonal variations in the groundwater flow regime, the Phase II monitoring event would also include comprehensive measurement of water levels in site-vicinity wells. Finally, the Phase II field program would include carbon treatment of contaminated groundwater collected during the Phase I and II investigations.



This general description of the recommended Phase II scope of work is submitted to KDHE for purposes of discussion. Based on KDHE review of the Phase I results, we would like to discuss with you the Phase II scope of work that would best satisfy KDHE expectations for the project. Following KDHE/Golder agreement on the level of effort that is appropriate for Phase II, we will prepare a cost estimate for the scope of work agreed upon.

**GOLDER ASSOCIATES INC.**

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## TABLES



**TABLE 1**  
**MONITOR WELL CONSTRUCTION SUMMARY**

Monitor Well	Location		Elevation		Screened Interval				Riser		Sandpack Interval	
	Northing	Easting	Top of PVC	Ground Surface	Depth (fbgs)	Screen Length	Bottom	Top			Bottom	Top
P-2	2623.00	104.00	914.79	914.7	21.05	10	21.05	11.05	1 in.	893.65	893.65	906
P-4	1848.00	47.00	914.83	914.9	21.87	10	21.87	11.87	1 in.	893.03	893.03	904.9
P-6	1630.00	-480.00	934.44	934.3	15.25	10	15.25	5.25	1 in.	919.05	919.05	931.3
P-7	2086.00	-1326.00	959.19	956.3	15.11	5	15.11	10.11	1 in.	941.19	941.19	950.3
P-9	2577.00	-1077.00	944.53	942.4	10.27	5	10.27	5.27	1 in.	932.13	932.13	939.4
P-10	2766.00	-722.00	927.79	927.6	14.55	10	14.55	4.55	1 in.	913.05	913.05	924.4
P-12	2951.00	222.00	913.99	913.8	21.16	10	21.16	11.16	1 in.	892.64	892.64	904.5
P-14	2041.00	476.00	914.92	914.2	24.55	10	24.55	14.55	1 in.	889.65	889.65	901.9
P-16	1534.00	271.00	914.18	914	21.87	10	21.87	11.87	1 in.	892.13	892.13	904
P-18	2375.00	775.00	915.52	911.3	20.68	10	20.68	10.68	1 in.	890.62	890.62	903.1
P-19	2012.00	915.00	914.42	911.8	20.93	10	20.93	10.93	1 in.	890.87	890.87	902.8

**Notes:**

Survey data provided by Cornerstone Surveying  
Locations based on the southeast corner of the appropriate sections  
Elevations relative to National Geodetic Vertical Datum of 1929 (NGVD 1929)  
Elevations based upon U.S.C. & G.S. Benchmark "X245 1934"  
All measurements provided in feet  
PVC = Polyvinyl chloride casing, 1-inch ID schedule 40  
Wells installed December 1997  
Water level elevations measured December 14, 1997

Monitor Well	Surface Casing		Top of Bedrock	Water Level	
	Diameter	Depth (bgs)		Elevation	
P-2	Flush Mount	2	893.3	911.41	
P-4	Flush Mount	2	892.6	911.46	
P-6	Flush Mount	2	931.3	926.74	
P-7	4x4 in. Steel	2	954.2	952.79	
P-9	4x4 in. Steel	2	940.9	940.65	
P-10	Flush Mount	2	912.1	924.28	
P-12	Flush Mount	2	893.1	912.25	
P-14	Flush Mount	2	890	910.33	
P-16	Flush Mount	2	892.9	911.47	
P-18	4x4 in. Steel	2	889.5	911.68	
P-19	4x4 in. Steel	2	890.8	909.52	





**TABLE 2**  
**PHASE I ANALYTE LIST**

<b>Purgeable Halocarbons</b>		
Bromodichloromethane	1,3-Dichlorobenzene	Methylene Chloride
Bromoform	1,4-Dichlorobenzene	1,1,2,2-Tetrachloroethane
Bromomethane	Dichlorodifluoromethane	Tetrachloroethene
Carbon Tetrachloride	1,1-Dichloroethane	1,1,1-Trichloroethane
Chlorobenzene	1,2-Dichloroethane	1,1,2-Trichloroethane
Chloroethane	1,1-Dichloroethene	Trichloroethene
Chloroform	trans-1,2-Dichloroethene	Trichlorofluoromethane
Chloromethane	1,2-Dichloropropane	Vinyl Chloride
Dibromochloromethane	cis-1,3-Dichloropropene	
1,2-Dichlorobenzene	trans-1,3-Dichloropropene	
<b>Purgeable Aromatics</b>		
Benzene	Methyl tert-Butyl Ether	Toluene
Ethylbenzene	Naphthalene	Xylenes (o,m,p)

Note: Samples were also submitted for TPH analyses using Method OA-2.



TABLE 3

SUMMARY OF DETECTED CONTAMINANTS

		National Primary Drinking Water Standards MCL	UNITS																				M1	KDHE
ANALYTE				P2-S-1 (3.5')	P2-W-1	P2-W-1D	P3-S-1 (3.7')	P4-S-1 (3.8')	P4-W-1	P5-W-1	P7-S-1 (1.5')	P7-W-1	P7-W-1D	P9-W-1	P11-W-1	P12-W-1	P14-S-1D (2.5')	P18-S-1D (2.5')	P19-S-1 (3.0')	P20-S-1 (12.0')	P20-W-1	P20-W-1D		
Halogenated and Aromatic VOC's																								
Benzene	ppb	5	ND	16.8	12	ND	624	645	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	372		
Toluene	ppb	1000	17.9	9.08	2.9	ND	1340	367	15.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	19.6		
Ethylbenzene	ppb	700	40.2	7.24	ND	ND	673	148	2.18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Xylene (total)	ppb	440	44.2	ND	7.5	ND	1350	150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Total BTEX	ppb	NA	102.3	33.12	22.4	ND	3987	1310	29.28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	391.6		
Naphthalene	ppb	143	495	18.9	ND	ND	6170	202	ND	ND	ND	ND	ND	ND	ND	130	ND	ND	ND	ND	ND	ND		
Chloroform	ppb	NA	ND	ND	ND	ND	ND	ND	ND	6.7	ND	3.2	1.2	ND	4	ND	ND	ND	ND	ND	ND	ND		
Chloromethane <sup>1</sup>	ppb	5	ND	ND	ND	ND	ND	ND	ND	ND	440 <sup>1</sup>	ND	ND	ND	ND	420 <sup>1</sup>	400 <sup>1</sup>	ND	ND	ND	ND	ND		
Chlorobenzene	ppb	100	ND	ND	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.71	ND			
1,2-Dichlorobenzene	ppb	600	ND	ND	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2	ND			
1,4-Dichlorobenzene	ppb	75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND			
1,2-Dichloroethane	ppb	5	ND	4.85	4.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Total Petroleum Hydrocarbons																								
TPH	ppm	NA	45.9	0.552	ND	1.41	163	1.73	ND	2.63	ND	ND	ND	0.566	ND	ND	ND	4.67	243	1.68	ND	ND		

NOTES:

Soil Samples are Designated by "S" and are Accompanied by the Depth of Sample Collection

Water Samples are Designated by "W"

Duplicate Samples "D" were Analyzed Off-Site by Pace Analytical

ppb = parts per billion (µg/L-water; µg/kg-soil)

ppm = parts per million (mg/L-water; mg/kg-soil)

Wells sampled by Golder in December 1997 are included in this detection summary

<sup>1</sup> Chloromethane Concentrations of 530 ppb were Detected in the Pace Analytical Method Blank

ND = Not Detected. Refer to Appendices H and I for Minimum Detection Limits

No Std. = No standard

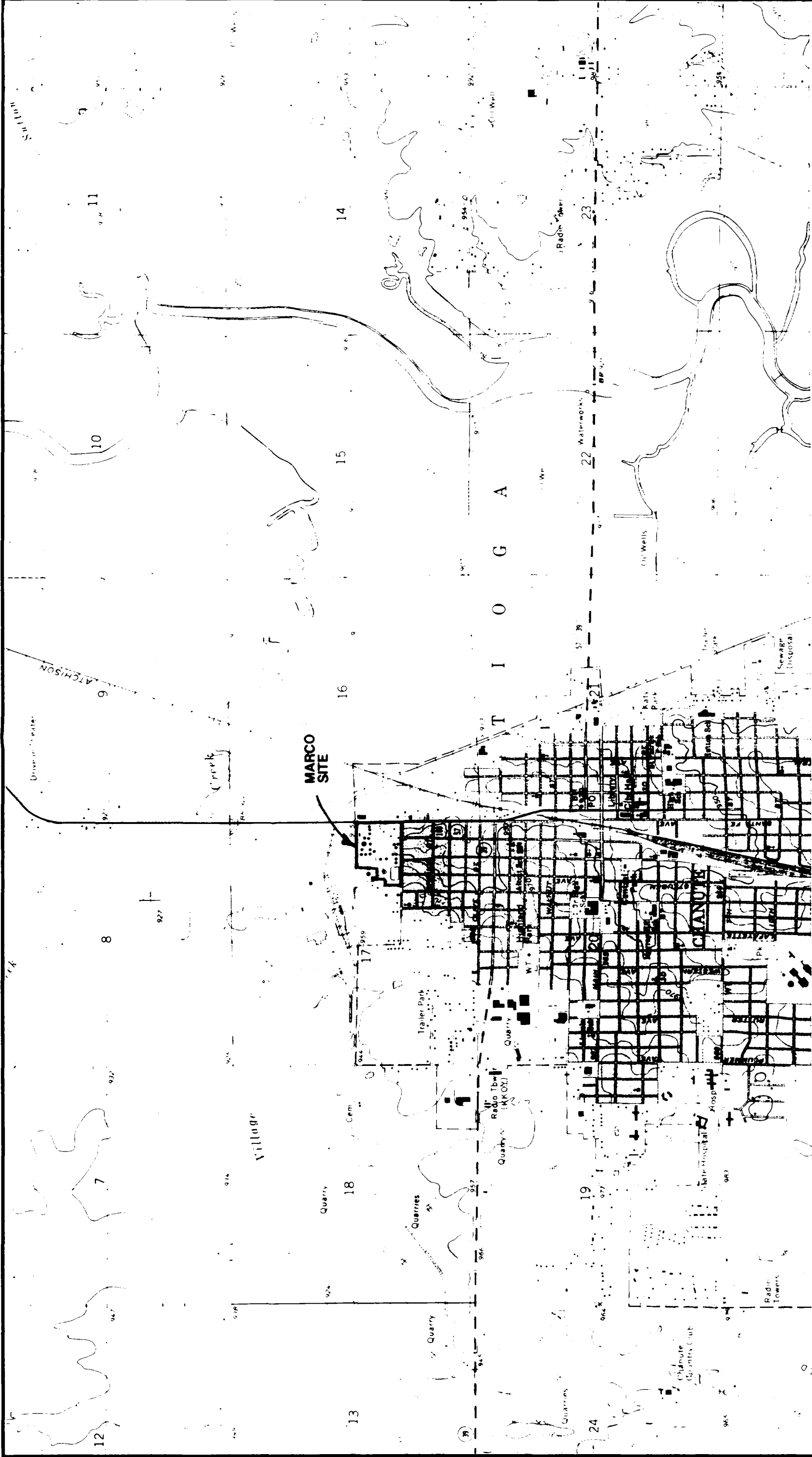
MCL = Maximum Concentration Limit, National Drinking Water Standards

NA = Not Available

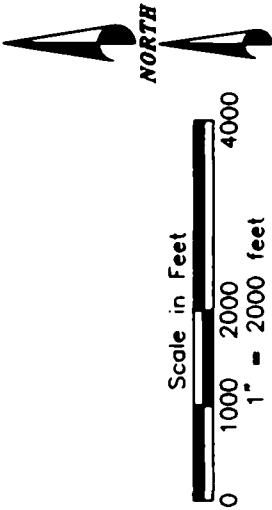


## FIGURES





Job No. / Dwg No. 973-2300 / B004  
Last Update 12:15p 1-Jan-98



TITLE		SITE LOCATION MAP			
CLIENT/PROJECT <b>Golden Associates</b> Denver, Colorado <b>KDHE</b> <b>MARCO INVESTIGATION</b>		DRAWN	RB	DATE	JAN. 1998
		CHECKED	RSM	SCALE	AS SHOWN
		REVIEWED	RSM	FILE NO	2300B004
				DWG NO./REV. NO	B004
				FIGURE NO	1



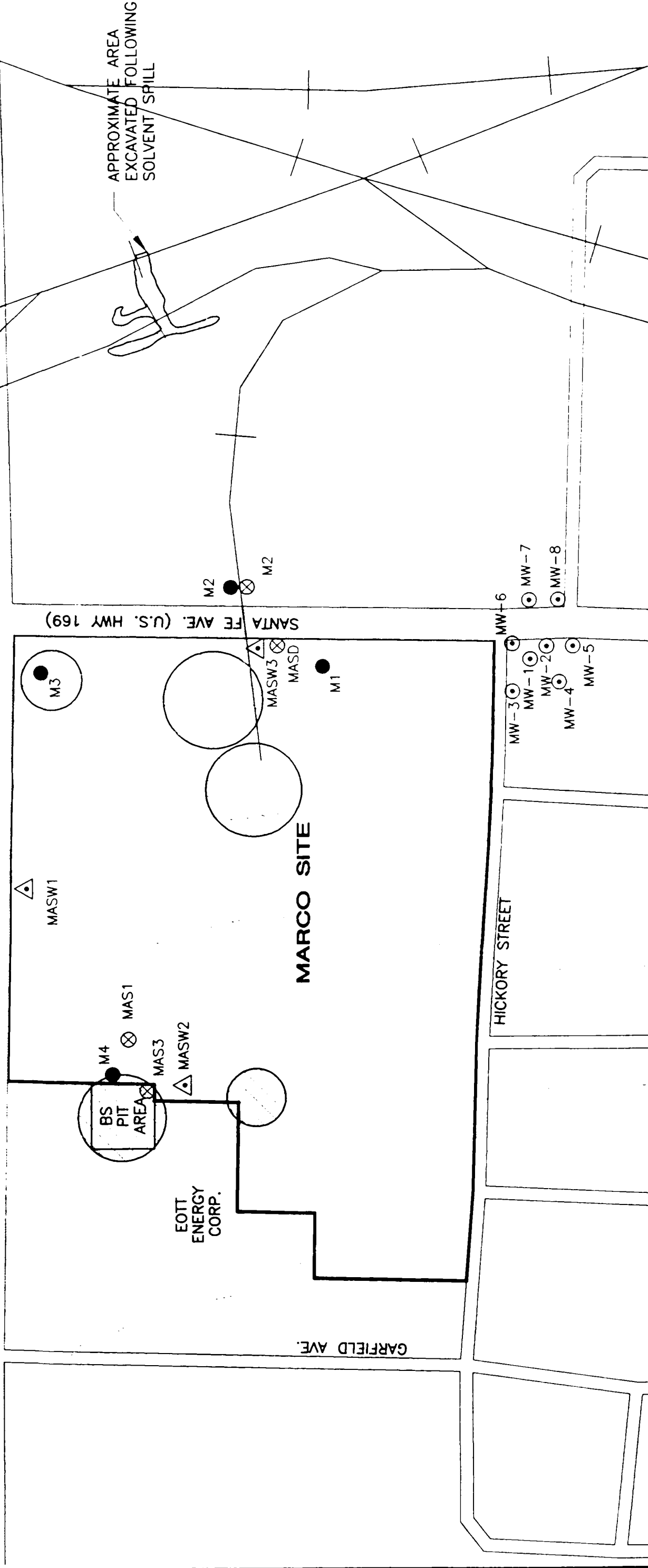


## NOTES:

1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC.
2. KDHE MONITOR WELL M2 NO LONGER EXISTS.
3. LOCATIONS OF KDHE SURFACE WATER AND SOLID SAMPLES ARE APPROXIMATE.

ASH GROVE CEMENT COMPANY

ASH GROVE ROAD



# LEGEND

- M3      EXISTING KDHE MONITOR WELL      △ MASW2      KDHE SURFACE WATER SAMPLE  
 ○ MW-6      OTHER EXISTING MONITOR WELL      ⊗ MASI      KDHE SOLID SAMPLE  
 ○      EXCLUSION ZONE DURING 1986 KDHE INVESTIGATION



**Denver, Colorado**

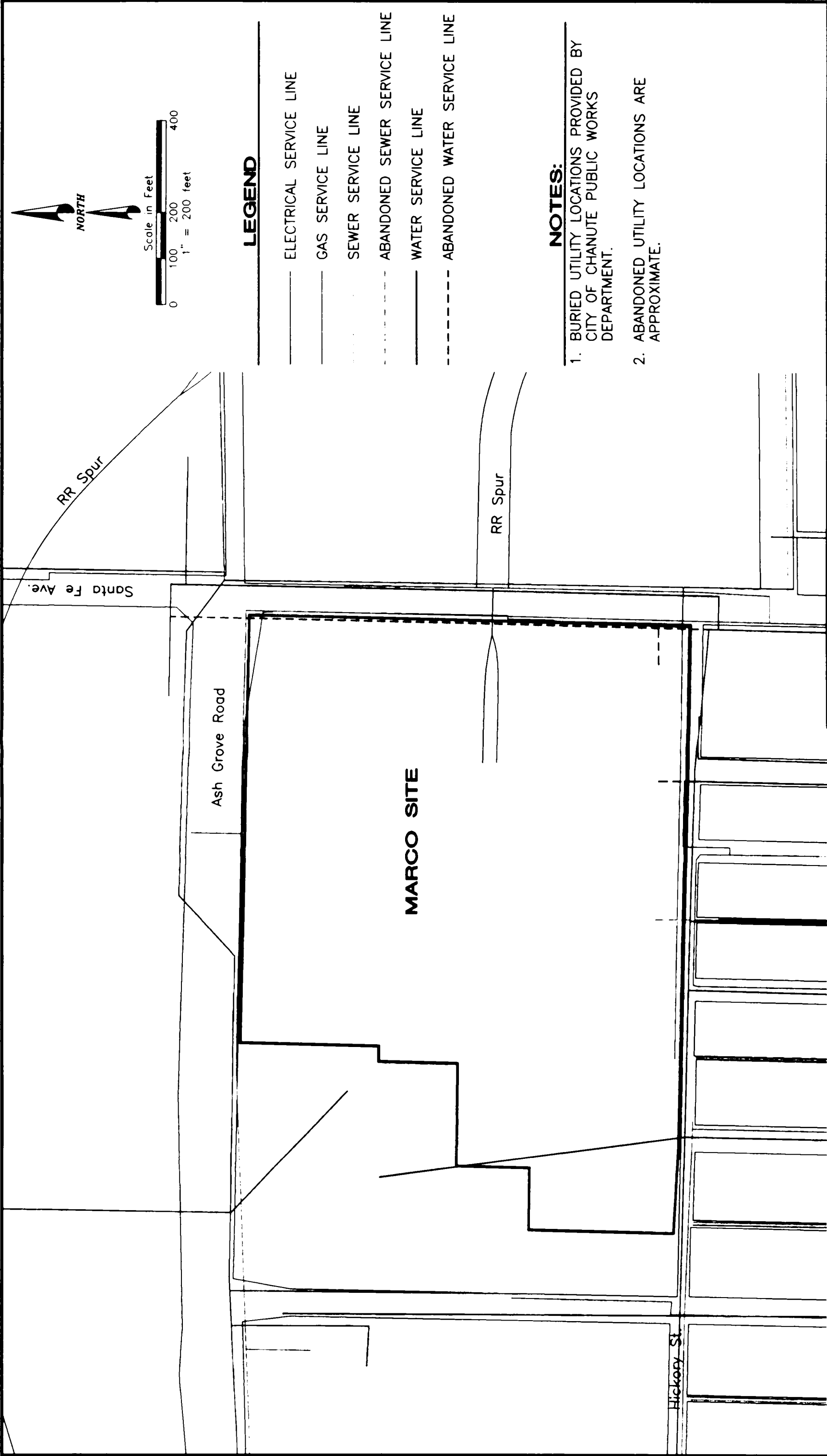
**KDHE  
MARCO INVESTIGATION**

Title

## PREVIOUS SAMPLING LOCATIONS

DRAWN	RB	DATE	JAN. 1998	JOB NO	973-2300.7
CHECKED	RSM	SCALE	AS SHOWN	DWG NO./REV NO	B006
REVIEWED	RSM	FILE NO	2300B006	FIGURE NO	2





MARCO SITE

Ash Grove Road

Santa Fe Ave.

RR Spur

RR Spur

Hickory St.

LEGEND

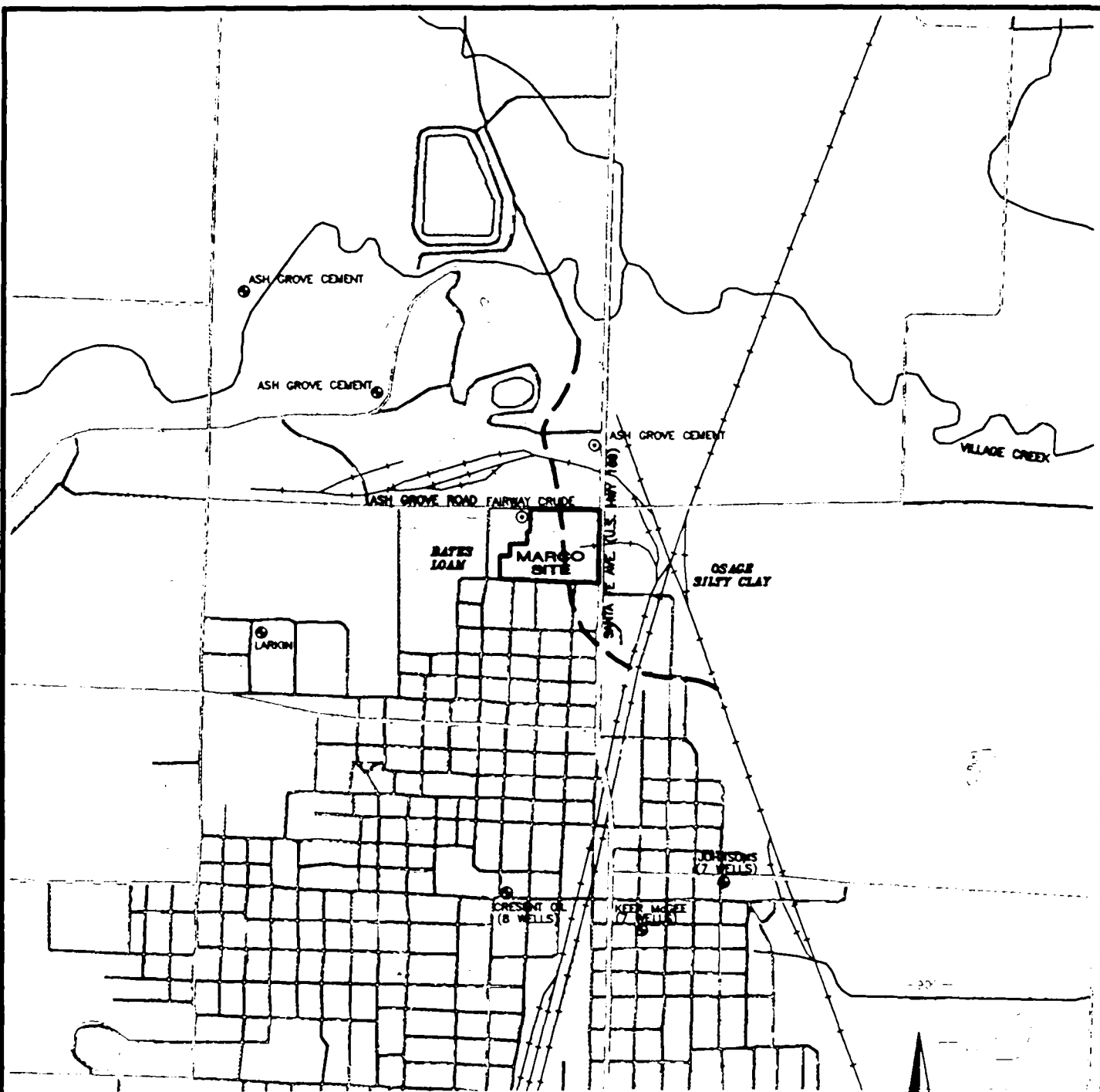
- ELECTRICAL SERVICE LINE
- GAS SERVICE LINE
- SEWER SERVICE LINE
- - - ABANDONED SEWER SERVICE LINE
- WATER SERVICE LINE
- - - ABANDONED WATER SERVICE LINE

NOTES:




1. BURIED UTILITY LOCATIONS PROVIDED BY CITY OF CHANUTE PUBLIC WORKS DEPARTMENT.
2. ABANDONED UTILITY LOCATIONS ARE APPROXIMATE.

Golder Associates		Denver, Colorado		TITLE		BURIED UTILITIES NEAR MARCO SITE	
CLIENT/PROJECT		KDHE		DRAWN	RB	DATE	JAN. 1998
MARCO INVESTIGATION		KDHE		CHECKED	RSM	SCALE	AS SHOWN
				REVIEWED	RSM	FILE NO	2300B003
				JOB NO		973-2300.7	
				DWG NO /REV NO		B003	
				FIGURE NO		3	





### LEGEND

-  LARKIN
-  FAIRWAY CRUDE
-  USDA SOIL TYPE BOUNDARY
- APPROXIMATE WATER WELL LOCATION
- PREVIOUS WATER WELL LOCATION
- USDA SOIL TYPE BOUNDARY



Scale in Feet  
0 1000 2000 4000  
1" = 2000 feet



Denver, Colorado

TITLE

### SITE-VICINITY GROUNDWATER WELLS

CLIENT/PROJECT

**KDHE  
MARCO INVESTIGATION**

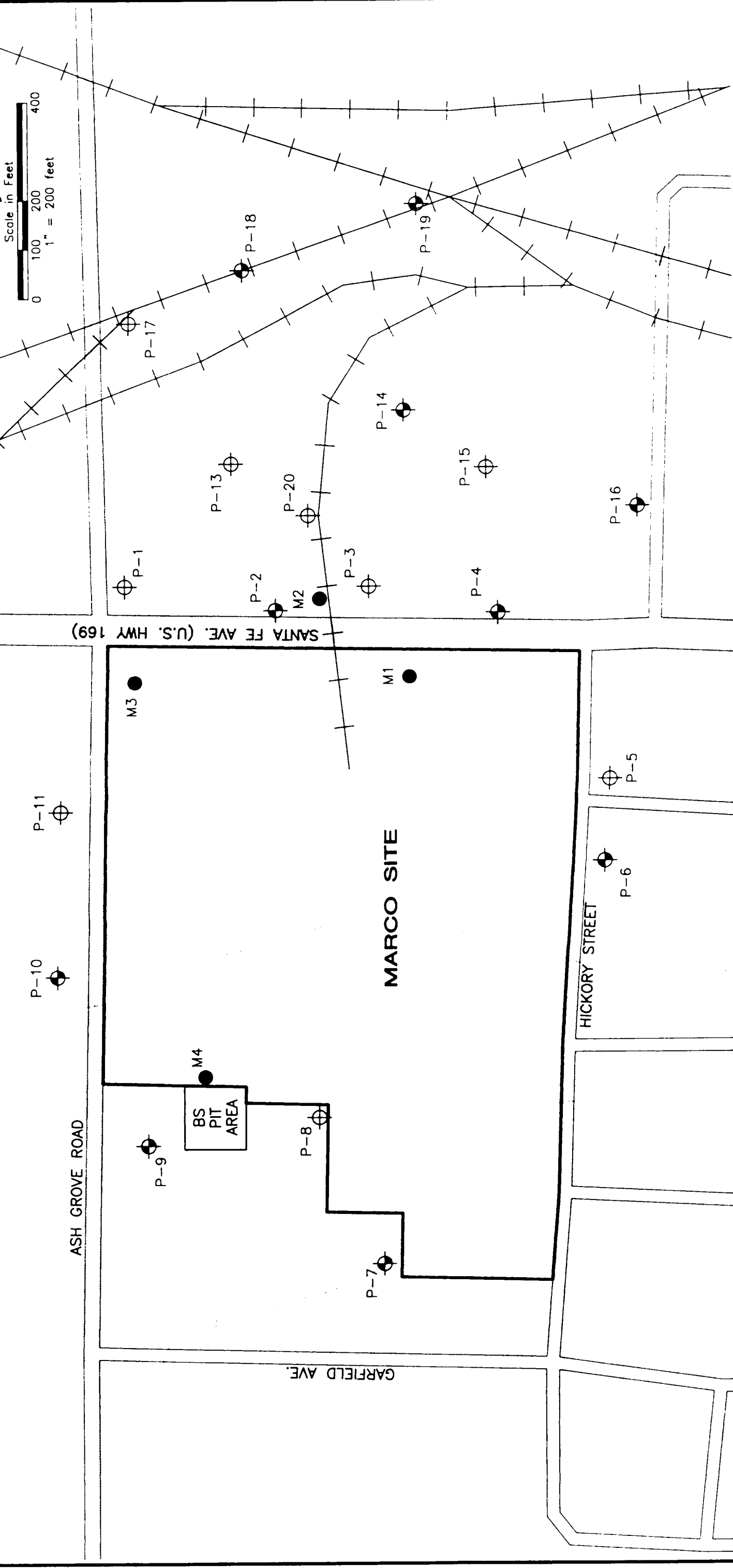
DRAWN	RB	DATE	JAN. 1998	JOB NO	973-2300.7
CHECKED	RSM	SCALE	AS SHOWN	DWG NO. REV NO	A005
REVIEWED	RSM	FILE NO.	2300A005	FIGURE NO	4



NOTES:

1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.

2. KDHE MONITOR WELL M2 NO LONGER EXISTS.



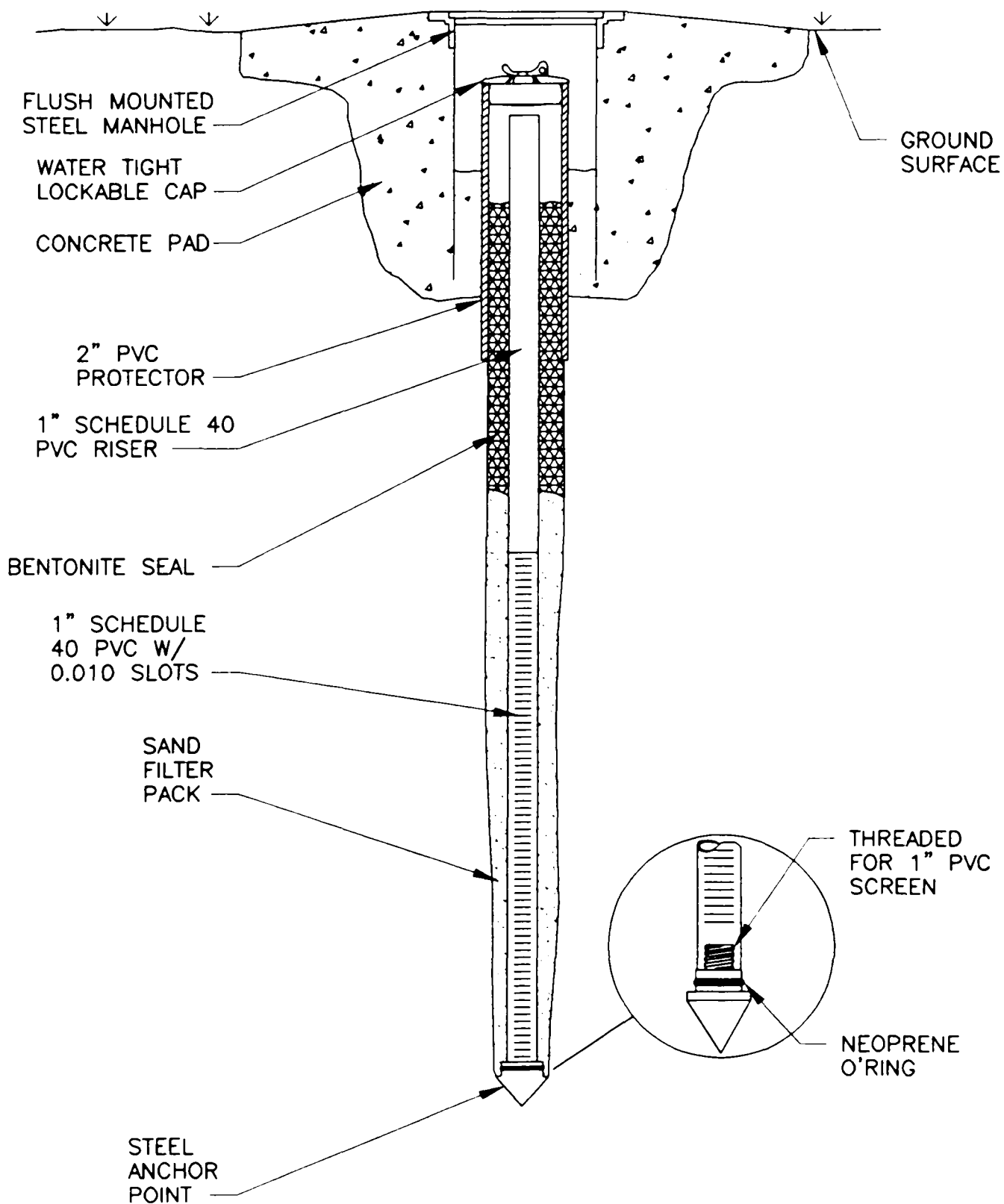
LEGEND

- P-1 PROBE LOCATION
- P-2 PROBE AND 1" WELL LOCATION
- M3 PREVIOUS KDHE MONITOR WELL

Golder Associates Denver, Colorado		PHASE I	
CLIENT/PROJECT		INVESTIGATIVE LOCATIONS	
MARCO INVESTIGATION		DATE	JAN. 1998
KDHE		DB/RB	MJK
AS SHOWN		SCALE	AS SHOWN
FIGURE NO		FIGURE NO	2300B008
JOB NO 973-2300.7		FIGURE NO	5







Denver, Colorado

CLIENT/PROJECT

**KDHE  
MARCO INVESTIGATION**

TITLE

## MINI-WELL SCHEMATIC

DRAWN RB

DATE JAN. 1998

JOB NO 973-2300.7

CHECKED RSM

SCALE N.T.S.

DWG NO. REV. NO. A007

REVIEWED RSM

FILE NO 2300A007

FIGURE NO 6

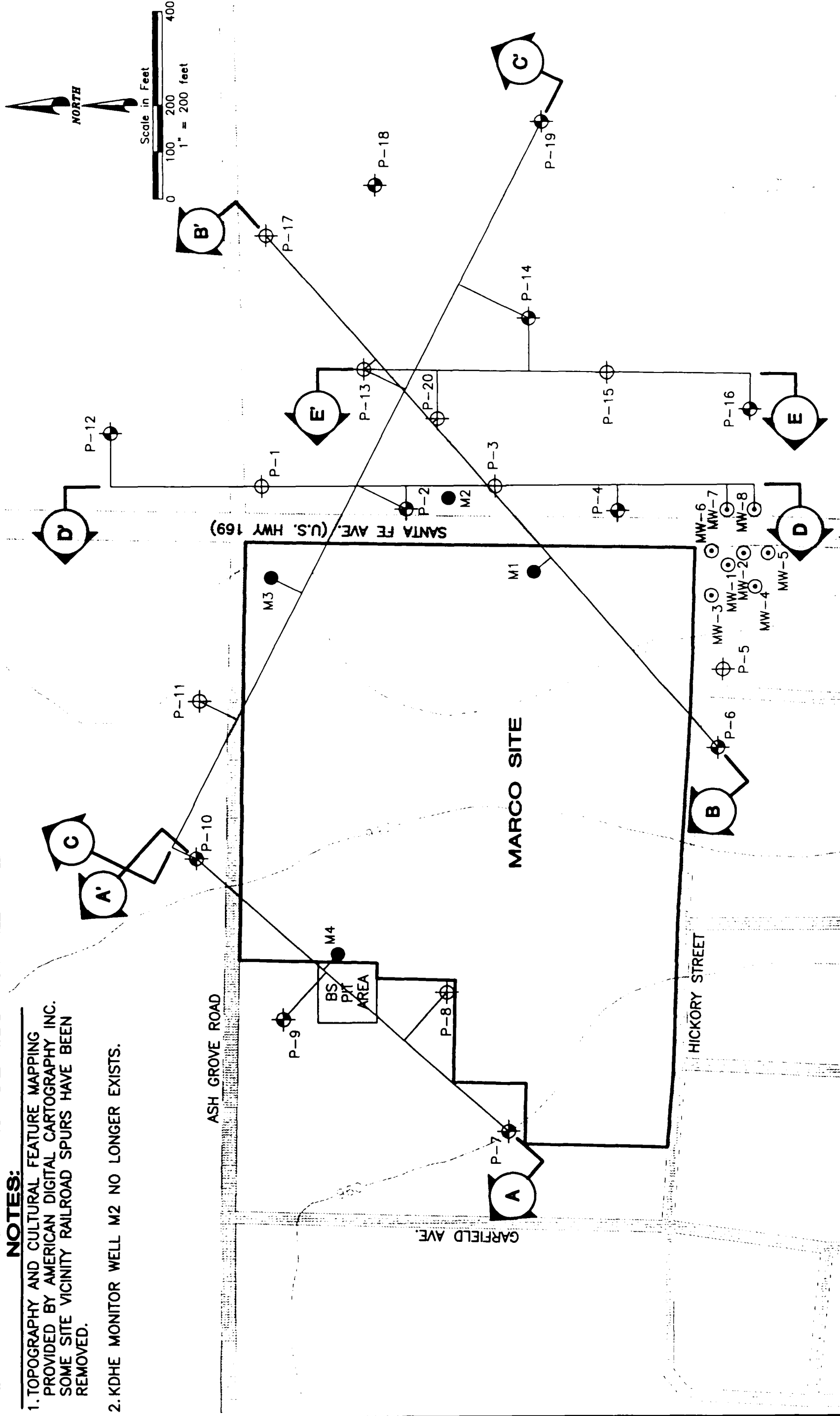
)

)

**NOTES:**

1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.

2. KDHE MONITOR WELL M2 NO LONGER EXISTS.



**LEGEND**

- P-1 PROBE LOCATION
- P-2 PROBE AND 1" WELL LOCATION
- M3 PREVIOUS KDHE MONITOR WELL
- MW-6 OTHER PREVIOUS MONITOR WELL

**CROSS-SECTION LOCATION**

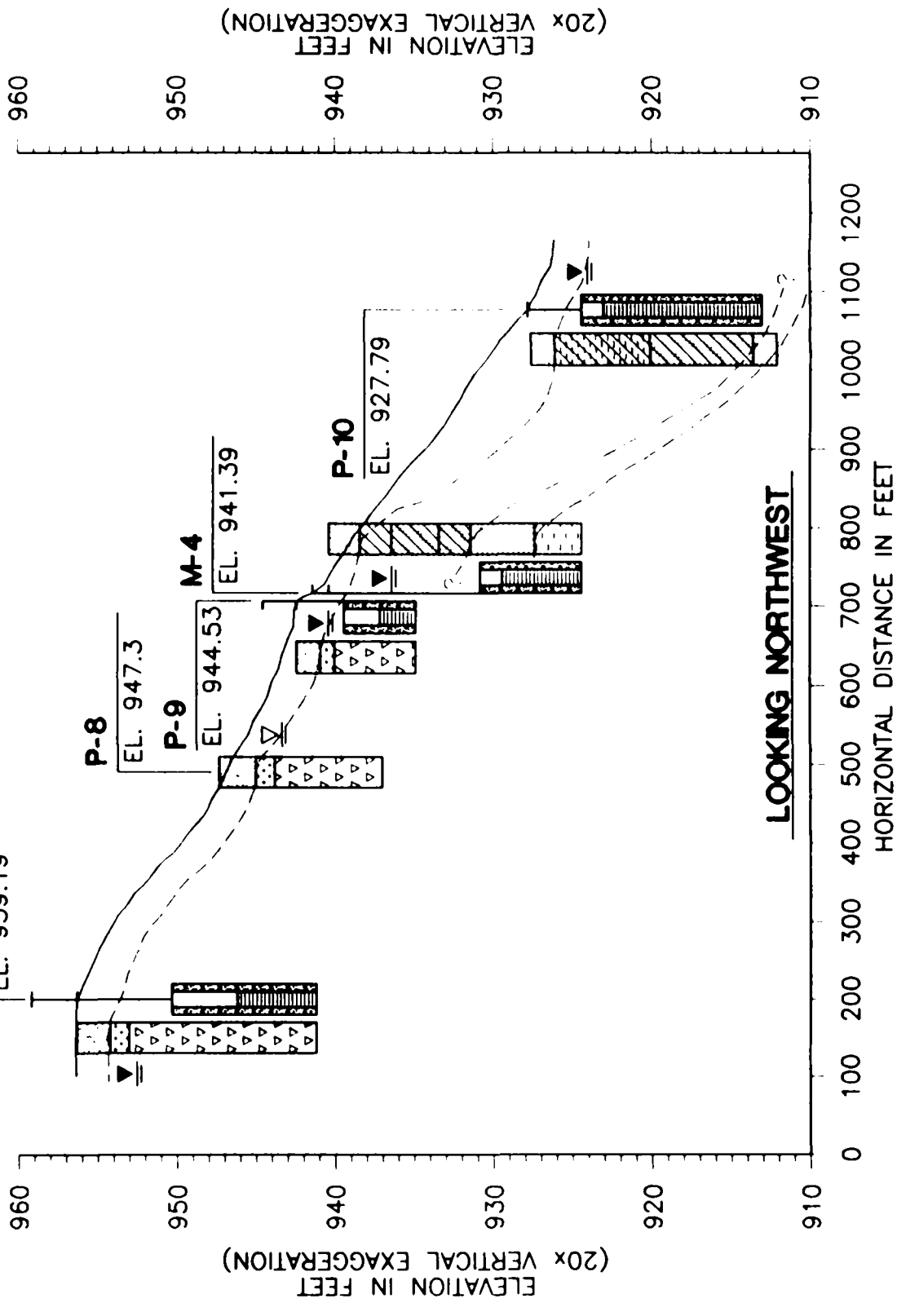
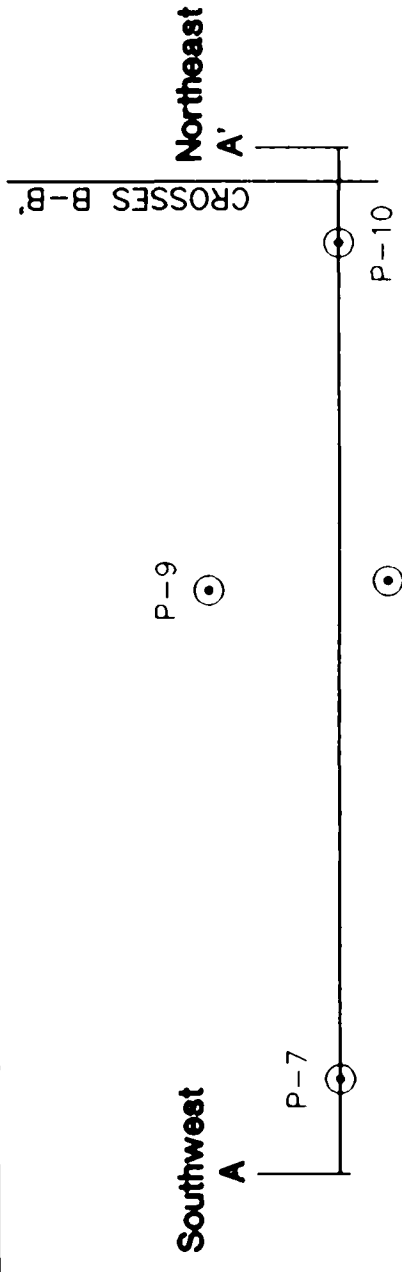
A-A' B-B' C-C' D-D' E-E'

**Goldier Associates** Denver, Colorado

CLIENT/PROJECT: **KDHE MARCO INVESTIGATION**

GEOLOGIC CROSS-SECTION LOCATION MAP			
TITLE	DRAWN	DATE	JAN. 1998
	DB/RB	SCALE	AS SHOWN
	CHECKED	FILE NO	2300B009
	REVIEWED	FIGURE NO	7
		JOB NO	973-2300.7
		DWC. NO./REV. NO	B009





DESCRIPTION OF MAP SYMBOLS

- Existing Topography
- Lithologic Contacts (Approximate)

DESCRIPTION OF MAP UNITS


- Topsoil/Fill
- Clay
- Silt
- Sand
- Gravel
- Sandstone
- Shale
- Undifferentiated Bedrock

**P-13**  
EL. 911.00  
**PROBE HOLE NUMBER**  
ELEVATION AT GROUND SURFACE (FT NGVD)  
GRAPHIC DEPICTION OF LITHOLOGY  
APPROXIMATE WATER LEVEL ELEVATION (UNSTABILIZED)

**P-6**  
EL. 934.44  
**MONITOR WELL NUMBER**  
ELEVATION AT TOP OF CASING (FT NGVD)  
WATER LEVEL ELEVATION (MEASURED 12/14/97)  
SANDPACK/SCREENED INTERVAL

NOTES:

- DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE, AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY AT EACH BOREHOLE LOCATION, REFER TO THE BOREHOLE LOGS.
- BOREHOLES AT MONITOR WELLS P-7, P-8 AND P-9 WERE AUGERED FROM BEDROCK CONTACT TO COMPLETION DEPTH. BEDROCK LITHOLOGIES WITHIN THE AUGERED ZONE ARE CHARACTERIZED AS UNDIFFERENTIATED.

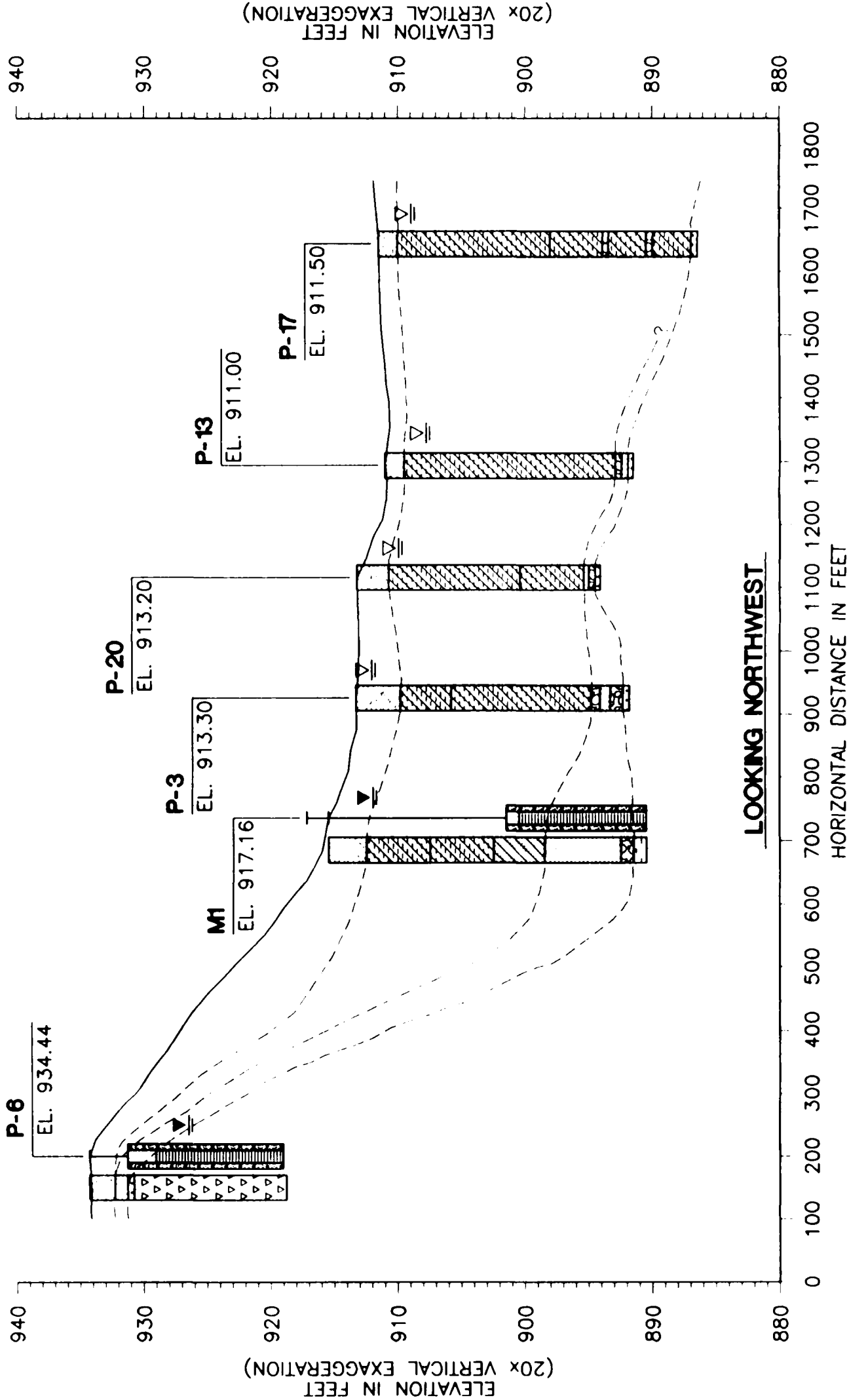
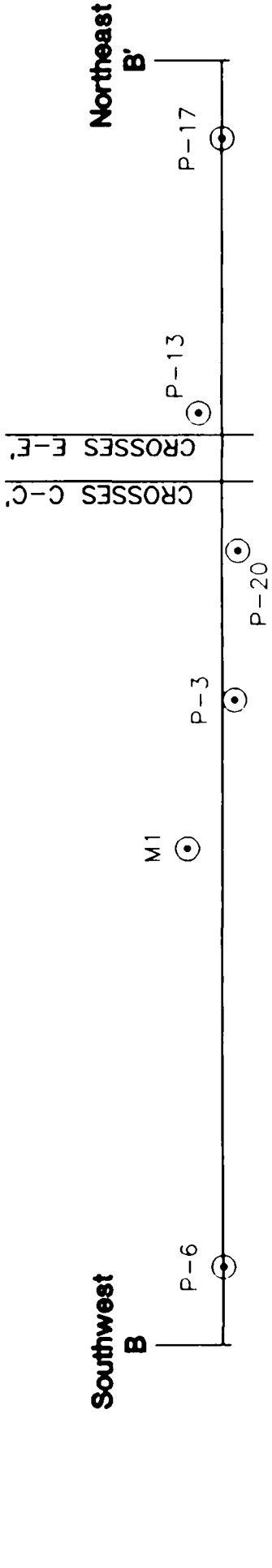
**Golder Associates** Denver, Colorado

**CLIENT/PROJECT**  
**KDHE**  
**MARCO INVESTIGATION**

**TITLE**  
**GEOLOGIC CROSS-SECTION A-A'**

DRAWN	RB	DATE	JAN. 1998	DWG NO	973-2300.7
CHECKED	MJK	SCALE	AS SHOWN	DWG NO, REV NO	B024
REVIEWED	RSM	FILE NO	2300B024	FIGURE NO	8





DESCRIPTION OF MAP SYMBOLS

- Existing Topography
- Lithologic Contacts (Approximate)

DESCRIPTION OF MAP UNITS

- Topsol/Fill
- Clay
- Silt
- Sand
- Gravel
- Sandstone
- Shale
- Undifferentiated Bedrock

PROBE HOLE NUMBER

ELEVATION AT GROUND SURFACE (FT NGVD)

GRAPHIC DEPICTION OF LITHOLOGY

APPROXIMATE WATER LEVEL ELEVATION (UNSTABILIZED)

MONITOR WELL NUMBER

ELEVATION AT TOP OF CASING (FT NGVD)

WATER LEVEL ELEVATION (MEASURED 12/14/97)

SANDPACK/SCREENED INTERVAL

NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE, AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY AT EACH BOREHOLE LOCATION, REFER TO THE BOREHOLE LOGS.
2. BOREHOLE AT MONITOR WELL P-6 WAS AUGERED FROM BEDROCK CONTACT TO COMPLETION DEPTH. BEDROCK LITHOLOGIES WITHIN THE AUGERED ZONE IS CHARACTERIZED AS UNDIFFERENTIATED.

**Golder Associates** Denver, Colorado

**KDHE**

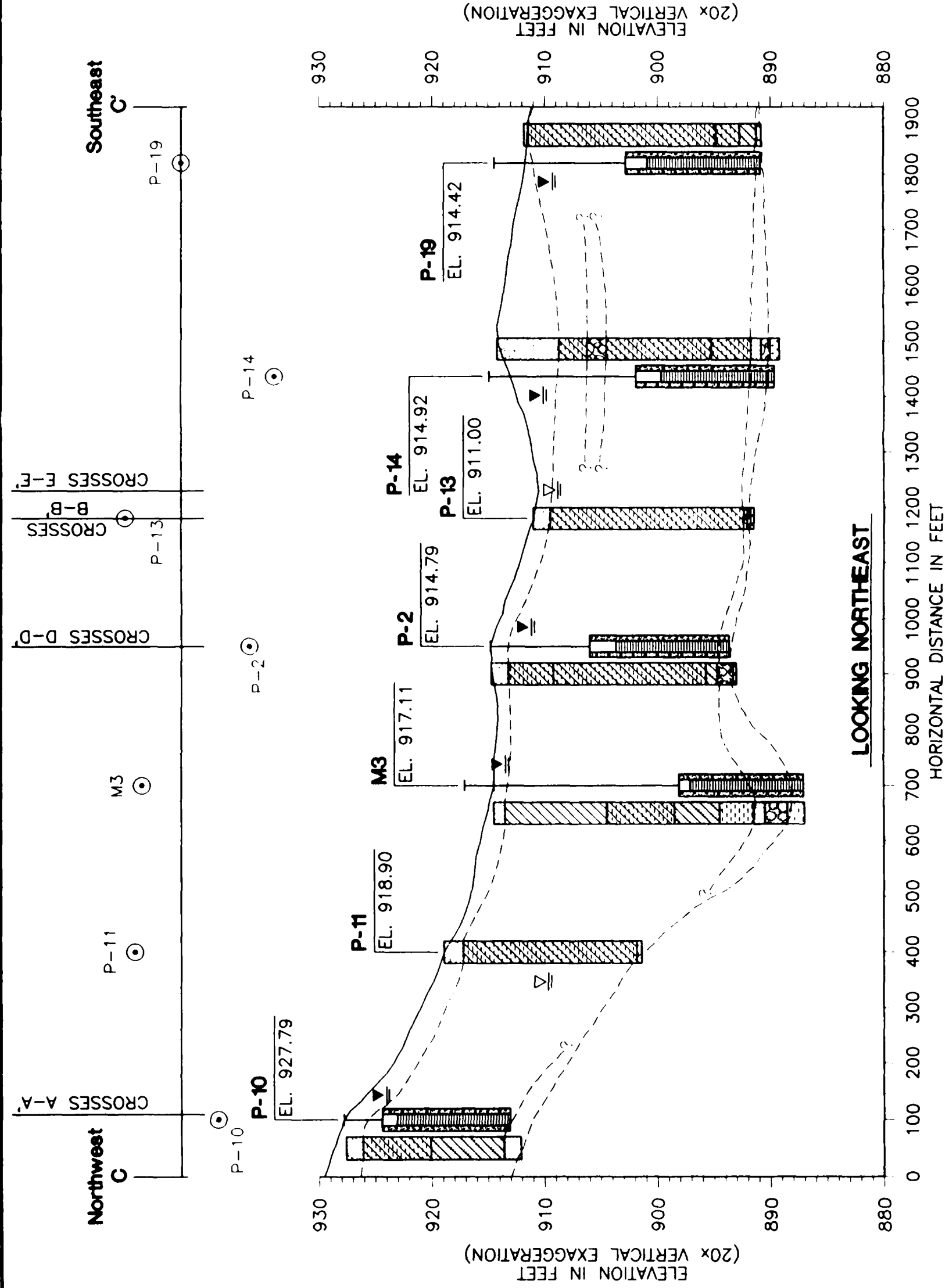
**MARCO INVESTIGATION**

CLIENT PROJECT

GEOLOGIC CROSS-SECTION B-B'			
DATE	RB	DATE	JAN. 1998
SCALE	MJK	AS SHOWN	SWG NO. REV NO
FILE NO	RSM	2300B025	FIGURE NO
			9







**NOTES:**

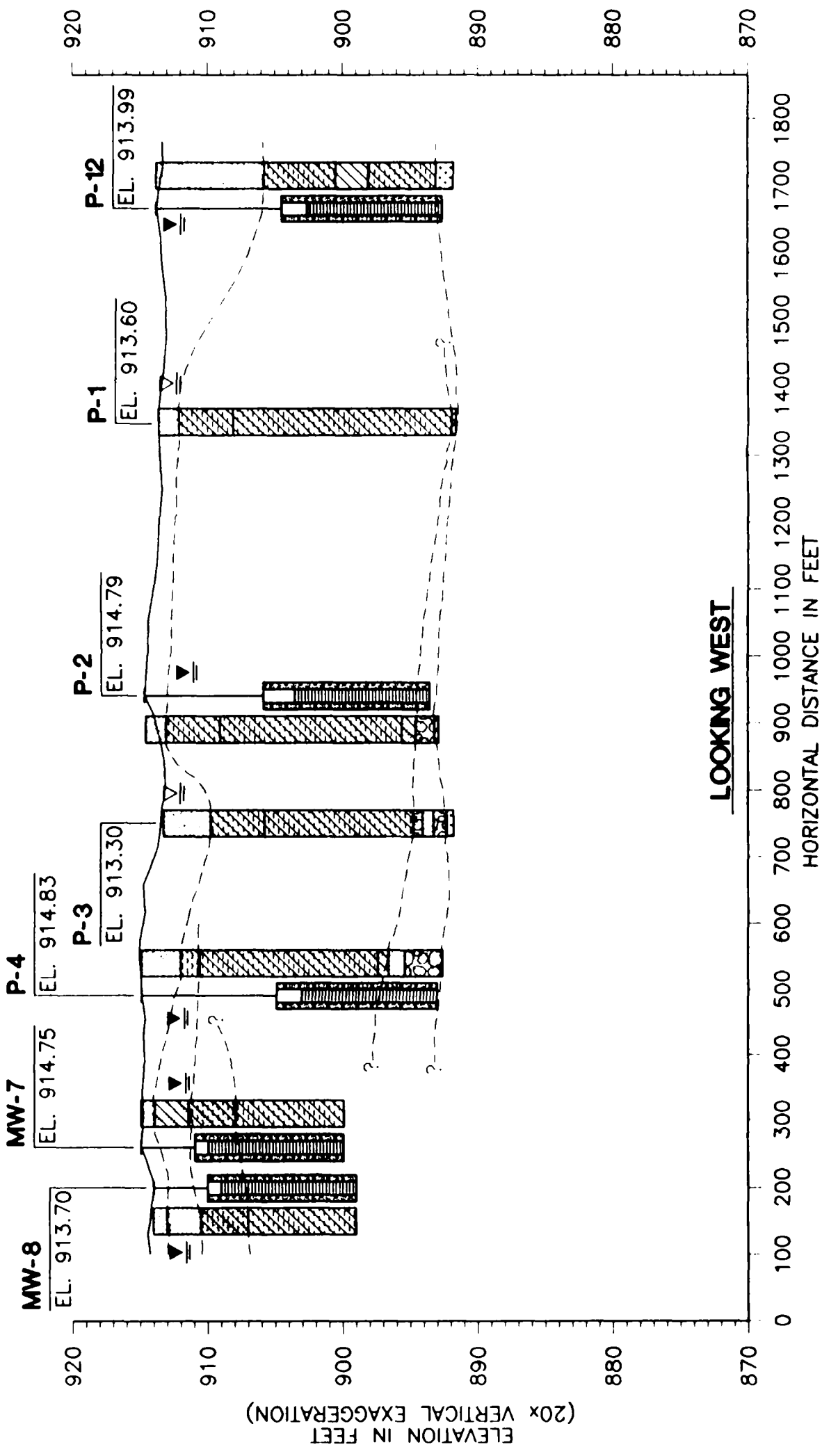
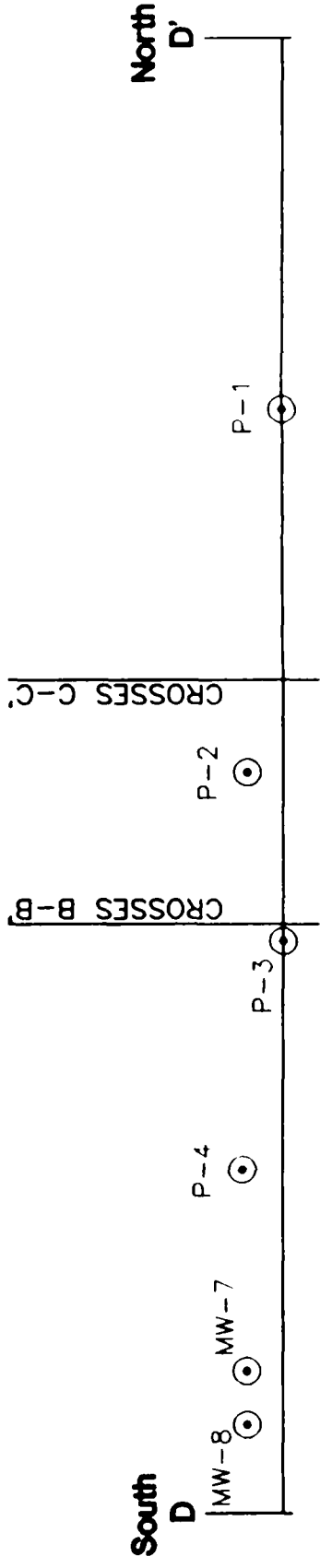
1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE, AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY AT EACH BOREHOLE LOCATION, REFER TO THE BOREHOLE LOGS.

**Golder Associates** Denver, Colorado

TITLE		GEOLOGIC CROSS-SECTION C-C'			
DRAWN	RB	DATE	JAN 1998	JOB NO.	973-2300
CHECKED	MJK	SCALE	AS SHOWN	DWG. NO./REV.	NO
REVIEWED	RSM	FILE NO.	2300B026	FIGURE NO.	10

**KDHE**  
**MARCO INVESTIGATION**





NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE, AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY AT EACH BOREHOLE LOCATION, REFER TO THE BOREHOLE LOGS.
2. WATER LEVEL ELEVATIONS FOR TERRACON WELLS MW-7 AND MW-8 MEASURED ON SEPTEMBER 9, 1997.
3. FILL MATERIAL AT P-12 INCLUDES ZONES OF KILN DUST DEPOSITED BY THE ASH CEMENT COMPANY.

DESCRIPTION OF MAP SYMBOLS

- Existing Topography
- Lithologic Contacts (Approximate)

DESCRIPTION OF MAP UNITS

- Topsol/Fill
- Clay
- Silt
- Sand
- Gravel
- Sandstone
- Shale
- Undifferentiated Bedrock

PROBE HOLE NUMBER  
ELEVATION AT GROUND  
SURFACE (FT NGVD)

- GRAPHIC DEPICTION  
OF LITHOLOGY
- APPROXIMATE WATER  
LEVEL ELEVATION  
(UNSTABILIZED)

MONITOR WELL NUMBER  
ELEVATION AT TOP OF  
CASING (FT NGVD)

WATER LEVEL ELEVATION  
(MEASURED 12/14/97)

SANDPACK/SCREENED  
INTERVAL

CLIENT/PROJECT

**Golden Associates** Denver, Colorado

**KDHE**

**MARCO INVESTIGATION**

TITLE

**GEOLOGIC CROSS-SECTION D-D'**

DRAWN	RB	DATE	JAN. 1998	JOB NO	973-2300.7
CHECKED	MJK	SCALE	AS SHOWN	DWG NO /REV NO	8027
REVIEWED	RSM	FILE NO	2300B027	FIGURE NO	11



DESCRIPTION OF MAP SYMBOLS

- Existing Topography
- Lithologic Contacts (Approximate)

DESCRIPTION OF MAP UNITS

- Topsoil/Fill
- Clay
- Silt
- Sand
- Gravel
- Sandstone
- Shale
- Undifferentiated Bedrock

PROBE HOLE NUMBER  
ELEVATION AT GROUND SURFACE (FT NGVD)

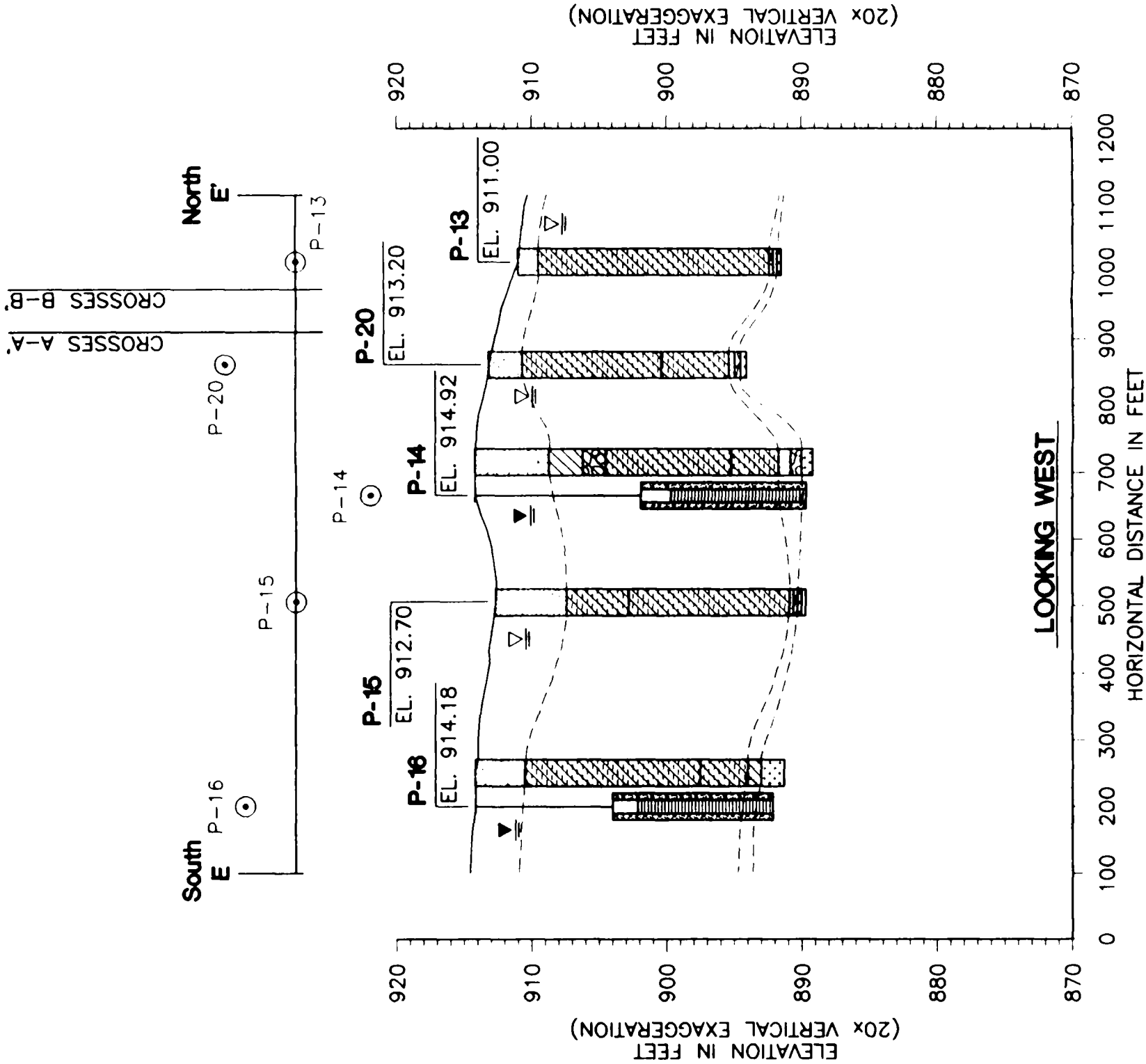
GRAPHIC DEPICTION OF LITHOLOGY

APPROXIMATE WATER LEVEL ELEVATION (UNSTABILIZED)

MONITOR WELL NUMBER  
ELEVATION AT TOP OF CASING (FT NGVD)

WATER LEVEL ELEVATION (MEASURED 12/14/97)

SANDPACK/SCREENED INTERVAL



NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE, AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY AT EACH BOREHOLE LOCATION, REFER TO THE BOREHOLE LOGS.

**Golden Associates** Denver, Colorado

CLIENT PROJECT

**KDHE**

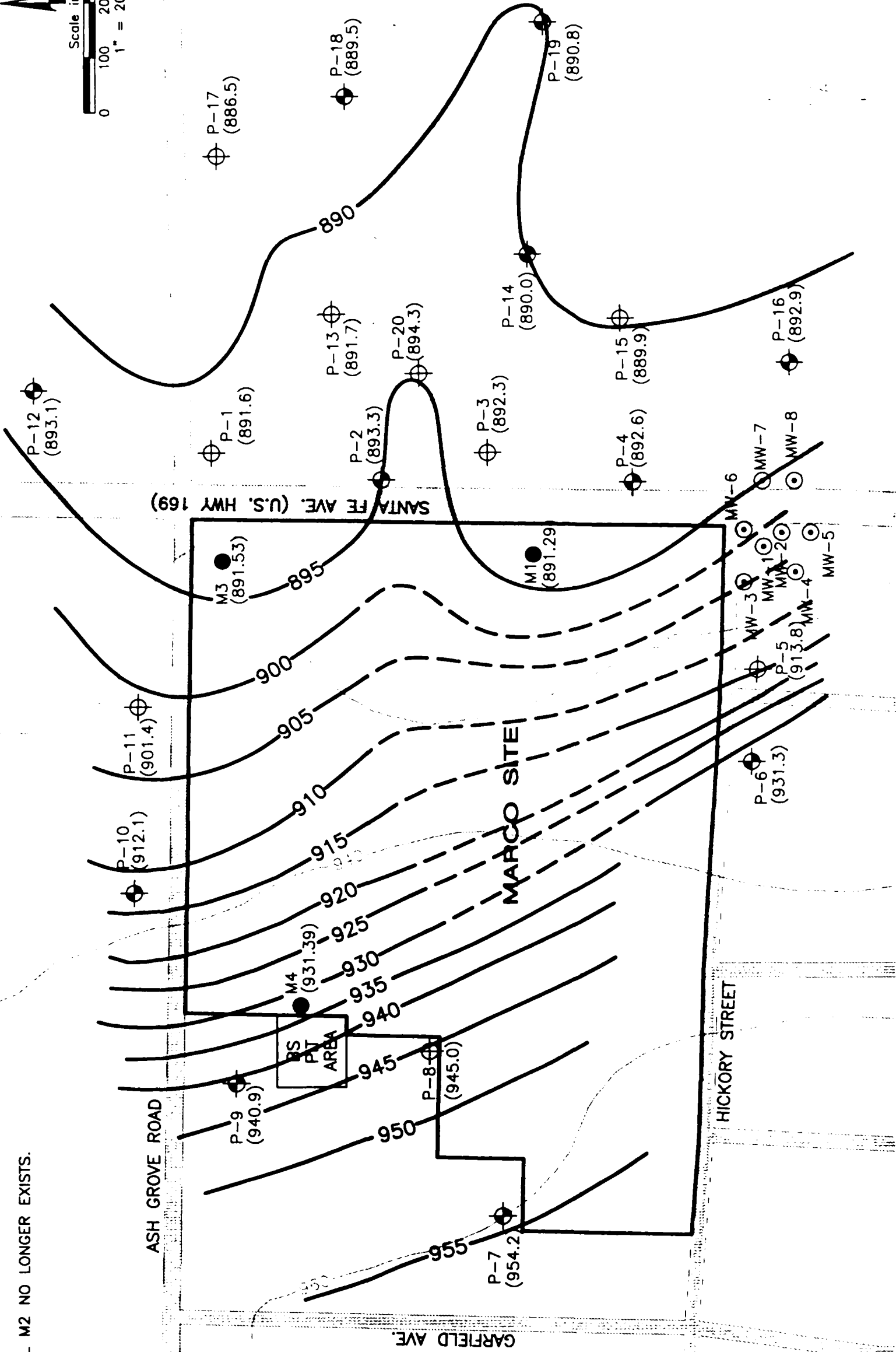
**MARCO INVESTIGATION**

TITLE		GEOLOGIC CROSS-SECTION E-E'			
DRAWN	RB	DATE	JAN. 1998	JOB NO	973-2300.7
CHECKED	MJK	SCALE	AS SHOWN	DWG NO	REV NO
REVIEWED	RSM	FILE NO	2300B028	FIGURE NO	12




NOTES:

- 1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
- 2. KDHE MONITOR WELL M2 NO LONGER EXISTS.



LEGEND

- P-1 (891.6) PROBE LOCATION
- P-2 (893.3) PROBE AND 1" WELL LOCATION
- M3 (891.53) PREVIOUS KDHE MONITOR WELL
- MW-6 OTHER PREVIOUS MONITOR WELL
- 890— LINE OF EQUAL ELEVATION (FT. NGVD 1929) (DASHED WHERE INFERRED)

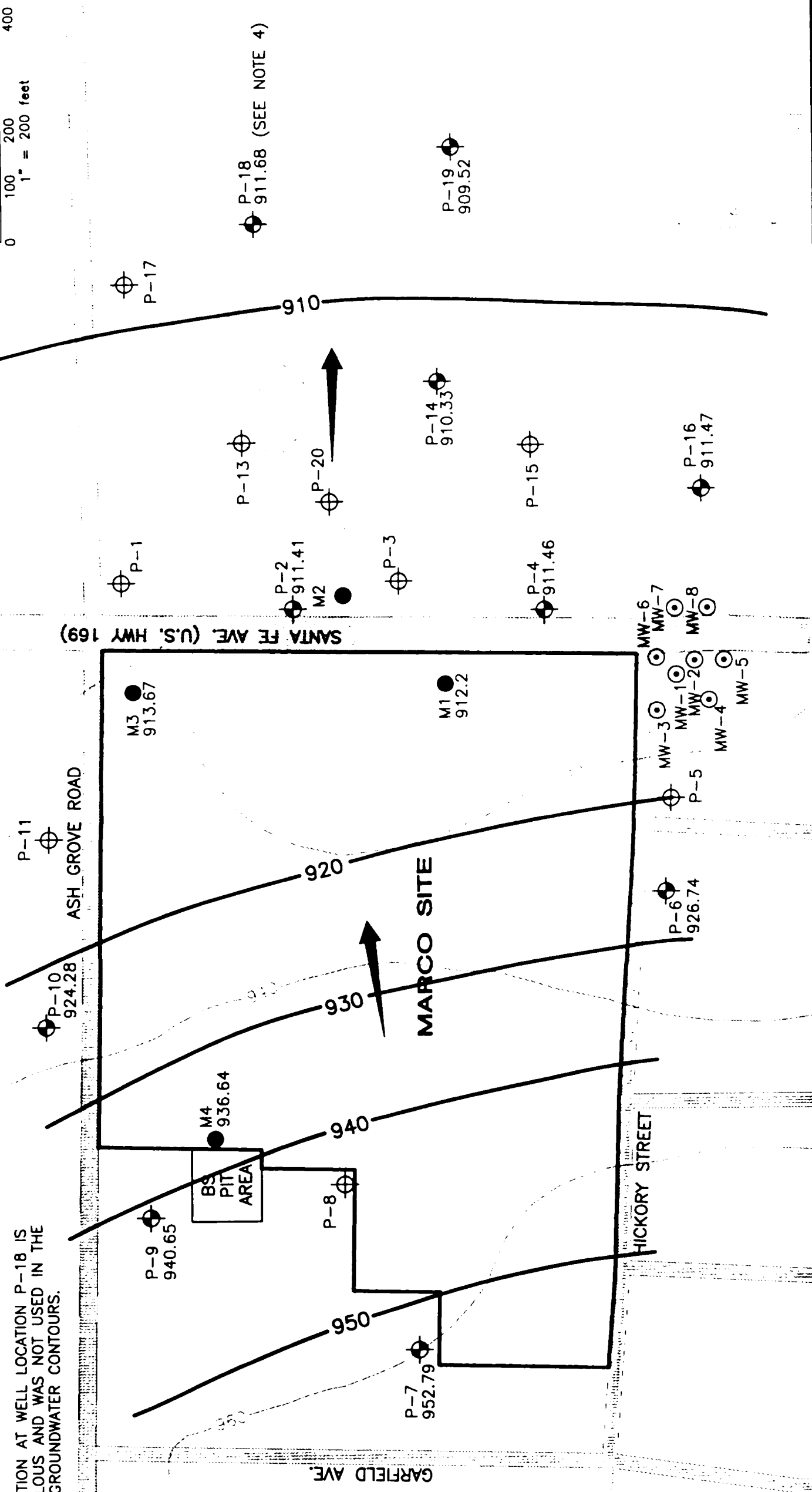
 <b>Golder Associates</b> Denver, Colorado		<b>TOP OF BEDROCK MAP</b>						
CLIENT/PROJECT	<b>KDHE</b> <b>MARCO INVESTIGATION</b>		DRAWN	DB	DATE	JAN. 1998	JOB NO	973-2300.7
			CHECKED	MJK	SCALE	AS SHOWN	DWG. NO./REV. NO	8011
			REVIEWED	RSM	FILE NO	2300B011	FIGURE NO	13





NOTES:

1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
2. KDHE MONITOR WELL M2 NO LONGER EXISTS.
3. WATER LEVEL ELEVATION DATA COLLECTED ON DECEMBER 13<sup>th</sup> AND 14<sup>th</sup>, 1997.
4. WATER LEVEL ELEVATION AT WELL LOCATION P-18 IS CONSIDERED ANOMALOUS AND WAS NOT USED IN THE CONSTRUCTION OF GROUNDWATER CONTOURS.



LEGEND

- P-1 PROBE LOCATION
- P-2 PROBE AND 1" WELL LOCATION  
911.41 GROUNDWATER ELEVATION (FT. NGVD 1929)
- M3 PREVIOUS KDHE MONITOR WELL  
913.67 GROUNDWATER ELEVATION (FT. NGVD 1929)
- MW-6 OTHER PREVIOUS MONITOR WELL
- GENERALIZED DIRECTION OF GROUNDWATER FLOW
- 950 — ESTIMATED POTENTIOMETRIC SURFACE  
(FT. NGVD 1929) (DASHED WHERE INFERRED)

Golder Associates		Denver, Colorado	
CLIENT/PROJECT		KDHE MARCO INVESTIGATION	
TITLE		DECEMBER 14, 1997 POTENTIOMETRIC SURFACE MAP FOR UNCONSOLIDATED MATERIALS	
DRAWN	DB	DATE	JAN. 1998
CHECKED	MJK	SCALE	AS SHOWN
REVIEWED	RSM	FILE NO	2300B010
		JOB NO.	973-2300.7
		DWG. NO./REV. NO.	B010
		FIGURE NO.	14




1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.

2. KDHE MONITOR WELL M2 NO LONGER EXISTS.



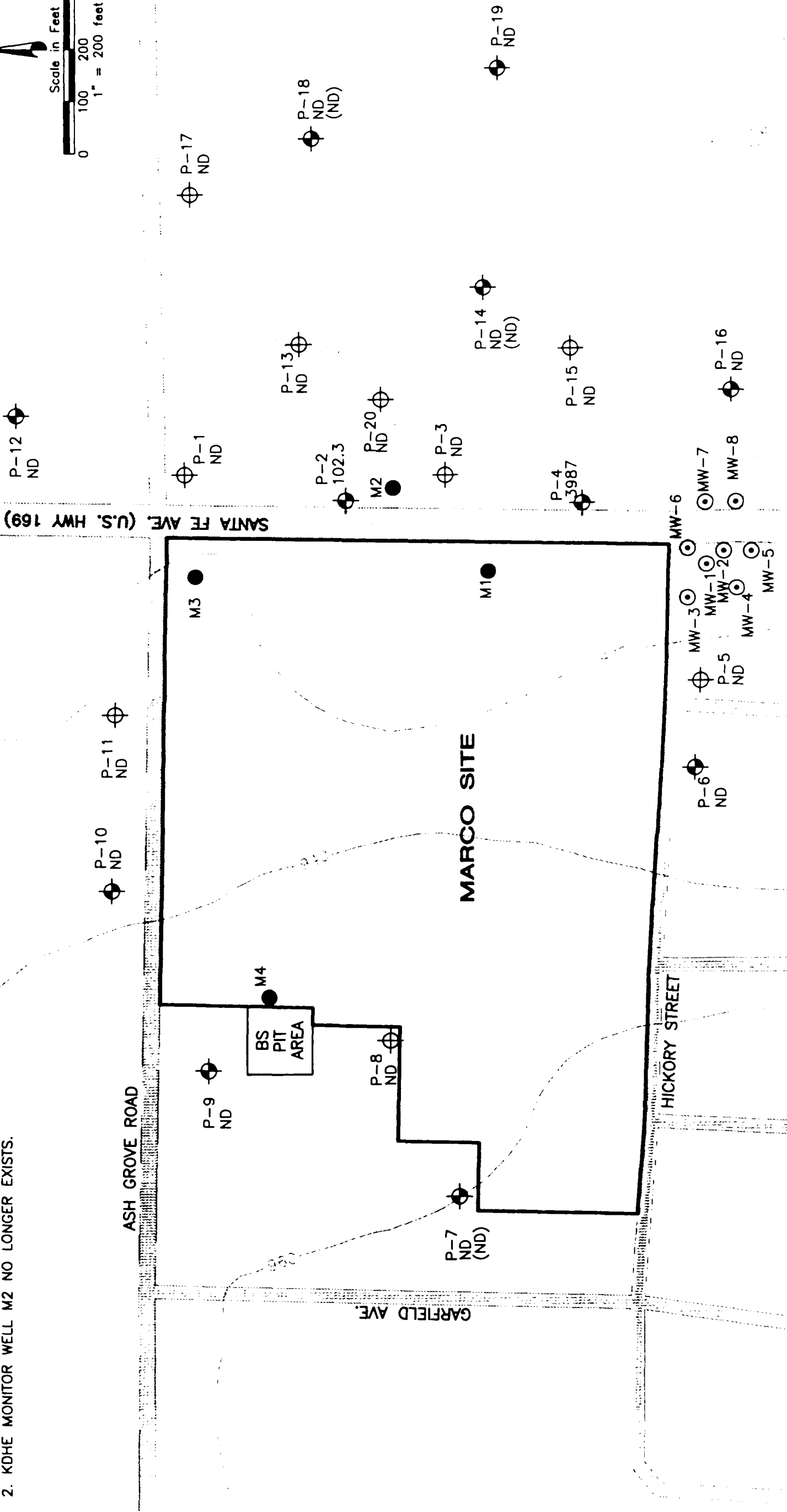
	PROBE LOCATION TPH CONCENTRATION (Mg/Kg)	TPH ISOCONCENTRATION CONTOUR (Mg/Kg) (DASHED WHERE INFERRED)	
⊕ P-1 ND		5	
⊕ P-2 45.9	PROBE AND 1" WELL LOCATION TPH CONCENTRATION (Mg/Kg)	ND	NON-DETECT
● M3	PREVIOUS KDHE MONITOR WELL	(ND)	PAGE ANALYTICAL DUPLICATE SAMPLE RESULT
⊙ MW-6	OTHER PREVIOUS MONITOR WELL		

 <b>Golder Associates</b> Denver, Colorado	<b>TITLE</b> <b>SOIL TPH ISOCONCENTRATION MAP</b> <b>DECEMBER 1987</b>					
	DRAWN	DB	DATE	JAN. 1988	JOB NO	973-2300.7
	CHECKED	MJK	SCALE	AS SHOWN	DWG. NO./REV. NO.	B012
	REVIEWED	RSM	FILE NO	2300B012	FIGURE NO	15
CLIENT/PROJECT <b>KDHE</b> <b>MARCO INVESTIGATION</b>						



1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.

SANTA FE AVE. (U.S. HWY 169)



PROBE LOCATION BTEx CONCENTRATION (Ug/Kg)	PROBE AND 1" WELL LOCATION BTEx CONCENTRATION (Ug/Kg)	PREVIOUS KDHE MONITOR WELL BTEx CONCENTRATION (Ug/Kg)	⊙ MW-6 OTHER PREVIOUS MONITOR WELL
⊙ P-1 ND			ND NON-DETECT
⊙ P-2 102.3			(ND) PACE ANALYTICAL DUPLICATE SAMPLE RESULT
● M3 ND			

**Golder Associates**      Denver, Colorado

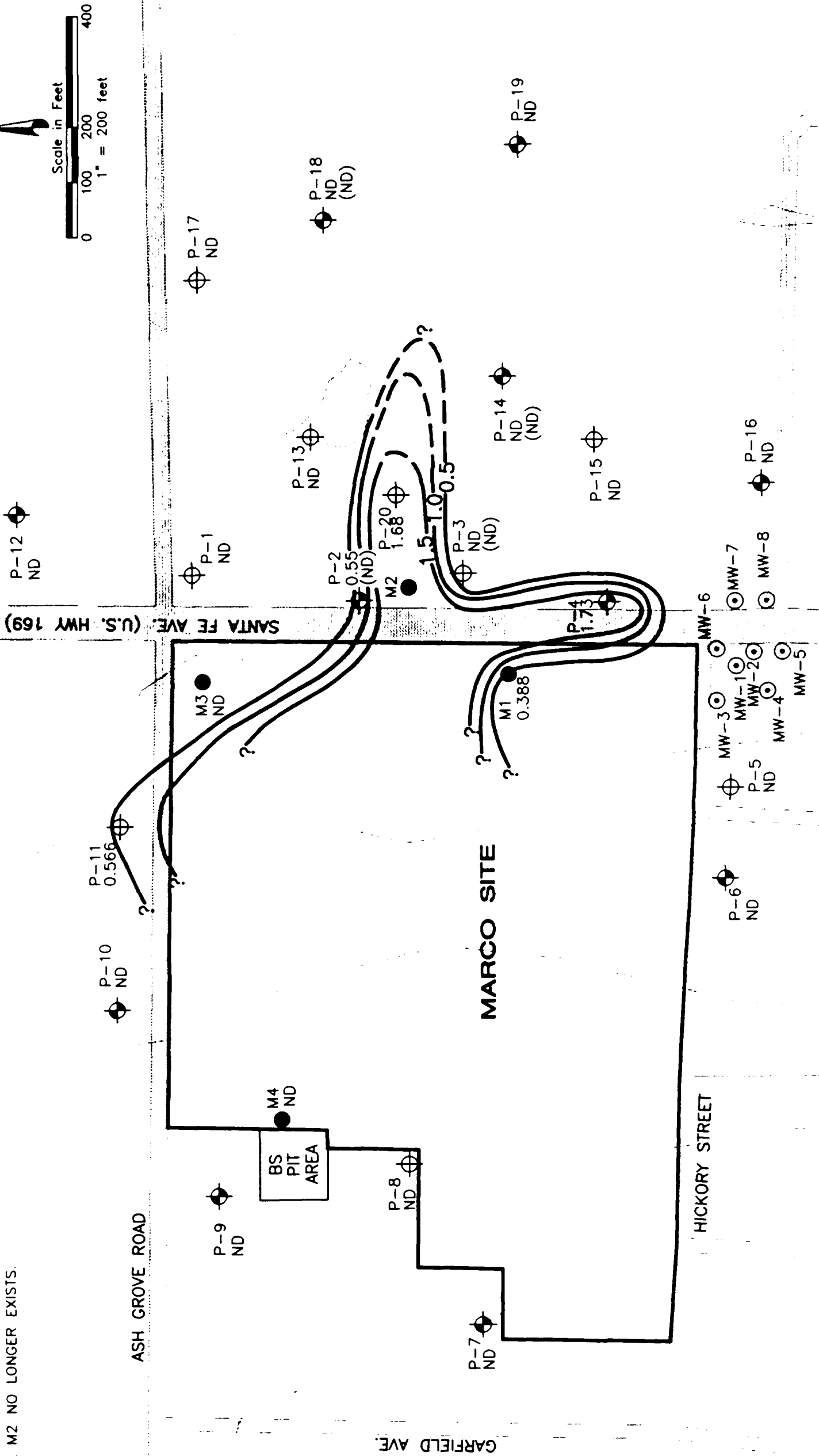
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**CLIENT/PROJECT**      **KDHE**  
**MARCO INVESTIGATION**




NOTES:

- 1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
- 2. KDHE MONITOR WELL M2 NO LONGER EXISTS.



LEGEND

- ⊕ P-1 ND PROBE LOCATION
- ⊕ P-2 0.55 (ND) TPH CONCENTRATION (Mg/L)
- M3 ND PROBE AND 1" WELL LOCATION
- ⊕ P-1 ND OTHER PREVIOUS MONITOR WELL
- 1.0 — (DASHED WHERE INFERRED) TPH ISOCONCENTRATION CONTOUR (Mg/L)
- ND NON-DETECT
- (ND) PAGE ANALYTICAL DUPLICATE SAMPLE RESULT
- ⊕ P-1 ND PREVIOUS KDHE MONITOR WELL
- ⊕ P-2 0.55 (ND) TPH CONCENTRATION (Mg/L)
- M3 ND PREVIOUS KDHE MONITOR WELL

**Golden Associates, Inc.**  
Denver, Colorado

**CUSTOMER/PROJECT**  
KDHE  
MARCO INVESTIGATION

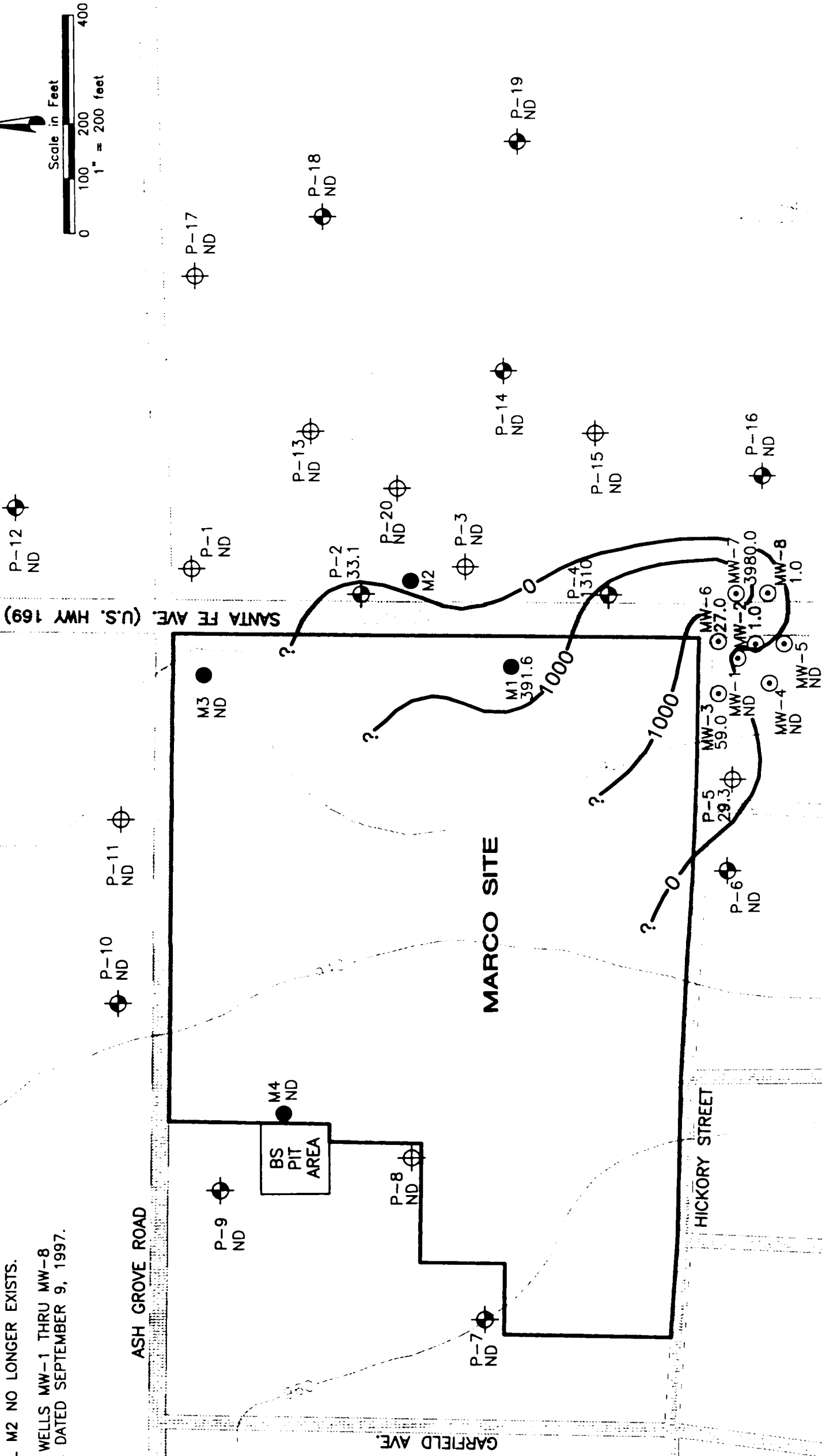
GROUNDWATER TPH ISOCONCENTRATION MAP DECEMBER 1997						
TITLE		DRAWN	DATE	DB	JAN. 1998	JOB NO. 973-2300.7
	CHECKED		SCALE	MJK	AS SHOWN	DWG. NO./REV. NO.
	REVIEWED		FILE NO.	RSM	2300B014	B014
						FIGURE NO.
						17






NOTES:

1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
2. KDHE MONITOR WELL M2 NO LONGER EXISTS.
3. TERRACON MONITOR WELLS MW-1 THRU MW-8 ANALYTICAL RESULTS DATED SEPTEMBER 9, 1997.



LEGEND

- Probe Location BTEX Concentration (Ug/L): P-1 ND, P-2 33.1, M3 ND.
- Probe and 1" Well Location BTEX Concentration (Ug/L): P-12 ND, P-13 ND, P-14 ND, P-15 ND, P-16 ND, P-17 ND, P-18 ND, P-19 ND.
- Previous KDHE Monitor Well BTEX Concentration (Ug/L): P-9 ND, P-10 ND, P-11 ND, P-7 ND, P-8 ND.
- Other Previous Monitor Well BTEX Concentration (Ug/L): MW-1 ND, MW-2 1.0, MW-3 59.0, MW-4 ND, MW-5 ND, MW-6 27.0, MW-7 3980.0, MW-8 1.0.
- BTEX Isoconcentration Contour (Ug/L): 1000 (solid line), 27.0 (dashed line).
- Non-Detect: ND.

**Gold Associates**  
Denver, Colorado

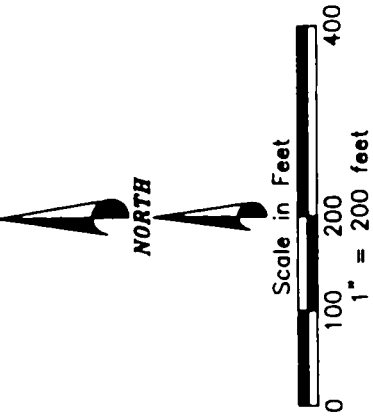
**KDHE**  
**MARCO INVESTIGATION**

TITLE		GROUNDWATER BTEX ISOCONCENTRATION MAP DECEMBER 1997			
DRAWN	DB	DATE	JAN. 1998	JOB NO 973-2300.7	
	CHECKED	MJK	SCALE	AS SHOWN	DWG. NO./REV. NO. B015
	REVIEWED	RSM	FILE NO	2300B015	FIGURE NO 18



NOTES:

- 1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
- 2. KDHE MONITOR WELL M2 NO LONGER EXISTS.
- 3. TERRACON MONITOR WELLS MW-1 THRU MW-8 ANALYTICAL RESULTS DATED SEPTEMBER 9, 1997.



ASH GROVE ROAD

BS  
PIT  
AREA

M4  
ND

P-9  
ND

GARFIELD AVE.

P-7  
ND  
(ND)

P-8  
ND

MARCO SITE

P-1  
ND

P-11  
ND

P-10  
ND

P-11  
ND

P-12  
ND

SANTA FE AVE. (U.S. HWY 169)

P-17  
ND

P-18  
ND  
(ND)

P-13  
ND

P-20  
ND  
(ND)

P-2  
16.8  
(12)

M1  
372

P-3  
ND  
(ND)

P-14  
ND  
(ND)

P-19  
ND

P-15  
ND  
(ND)

P-4  
645

P-16  
ND

HICKORY STREET

P-5  
12

P-6  
ND

MW-6  
3.2

MW-3  
18

MW-1  
ND

MW-2  
0.7

MW-4  
ND

MW-5  
ND

MW-7  
1200

MW-8  
ND

LEGEND

- ⊕ P-1 ND PROBE LOCATION
- ⊕ P-2 16.8 (12) BENZENE CONCENTRATION (Ug/L)
- M3 ND PROBE AND 1" WELL LOCATION
- M3 ND BENZENE CONCENTRATION (Ug/L)
- M3 ND PREVIOUS KDHE MONITOR WELL
- M3 ND BENZENE CONCENTRATION (Ug/L)

- ⊕ MW-6 OTHER PREVIOUS MONITOR WELL
- 3.2 BENZENE CONCENTRATION (Ug/L)
- 500— BENZENE ISOCONCENTRATION CONTOUR (Ug/L)
- (12) DASHED WHERE INFERRED
- ND NON-DETECT
- (12) PACE ANALYTICAL DUPLICATE SAMPLE RESULT



Denver, Colorado

CLIENT/PROJECT

KDHE

MARCO INVESTIGATION

TITLE

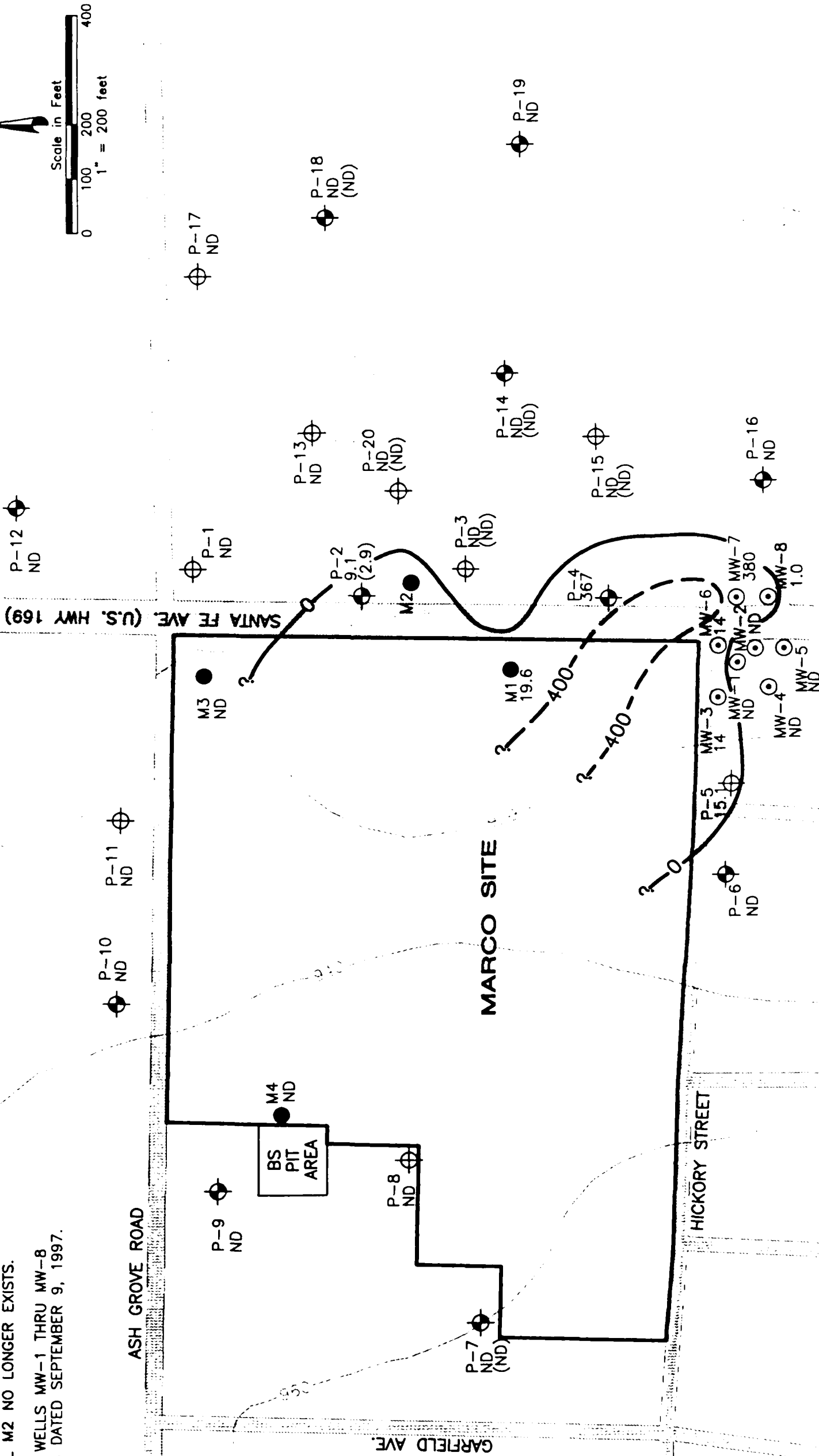
BENZENE ISOCONCENTRATION MAP  
DECEMBER 1997

DRAWN	DB	DATE	JAN. 1998	JOB NO.	973-2300.7
CHECKED	MJK	SCALE	AS SHOWN	DWG. NO./REV. NO.	B016
REVIEWED	RSM	FILE NO.	2300B016	FIGURE NO.	19




NOTES:

1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
2. KOHE MONITOR WELL M2 NO LONGER EXISTS.
3. TERRACON MONITOR WELLS MW-1 THRU MW-8 ANALYTICAL RESULTS DATED SEPTEMBER 9, 1997.



LEGEND

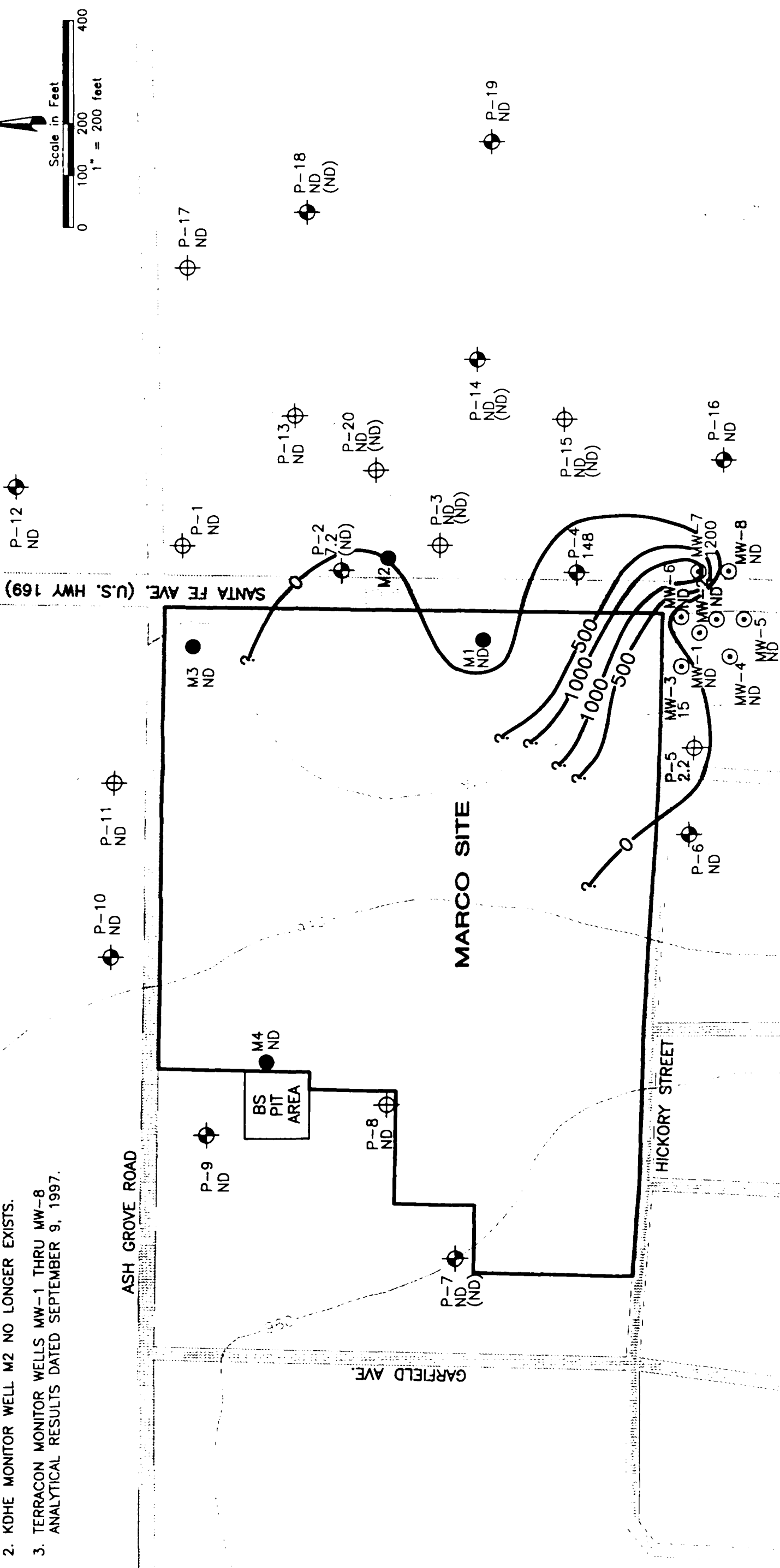
- ⊕ P-1 ND PROBE LOCATION TOLUENE CONCENTRATION (Ug/L)
- ⊕ P-2 9.1 (2.9) PROBE AND 1" WELL LOCATION TOLUENE CONCENTRATION (Ug/L)
- M3 ND PREVIOUS KOHE MONITOR WELL TOLUENE CONCENTRATION (Ug/L)
- ⊕ MW-6 14 OTHER PREVIOUS MONITOR WELL TOLUENE CONCENTRATION (Ug/L)
- 400 TOLUENE ISOCONCENTRATION CONTOUR (Ug/L) (DASHED WHERE INFERRED)
- ND NON-DETECT
- (2.9) PACE ANALYTICAL DUPLICATE SAMPLE RESULT

		Denver, Colorado	
CLIENT/PROJECT		KDHE	
		MARCO INVESTIGATION	
TITLE		GROUNDWATER TOLUENE ISOCONCENTRATION MAP DECEMBER 1997	
DRAWN	DB	DATE	JAN. 1998
CHECKED	MJK	SCALE	AS SHOWN
REVIEWED	RSM	FILE NO	2300B017
		JOB NO	973-2300.7
		DWG. NO./REV. NO.	B017
		FIGURE NO	20



NOTES:

- 1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
- 2. KDHE MONITOR WELL M2 NO LONGER EXISTS.
- 3. TERRACON MONITOR WELLS MW-1 THRU MW-8 ANALYTICAL RESULTS DATED SEPTEMBER 9, 1997.



LEGEND

P-1 ND	PROBE LOCATION	MW-6	OTHER PREVIOUS MONITOR WELL
P-2 7.2 (ND)	ETHYLBENZENE CONCENTRATION (Ug/L)	3.2	ETHYLBENZENE CONCENTRATION (Ug/L)
M3 ND	PROBE AND 1" WELL LOCATION	500	ETHYLBENZENE ISOCONCENTRATION CONTOUR (Ug/L) (DASHED WHERE INFERRED)
	ETHYLBENZENE CONCENTRATION (Ug/L)	ND	NON-DETECT
	PREVIOUS KDHE MONITOR WELL	(ND)	PACE ANALYTICAL DUPLICATE SAMPLE RESULT
	ETHYLBENZENE CONCENTRATION (Ug/L)		



CLIENT/PROJECT  
**KDHE**  
**MARCO INVESTIGATION**

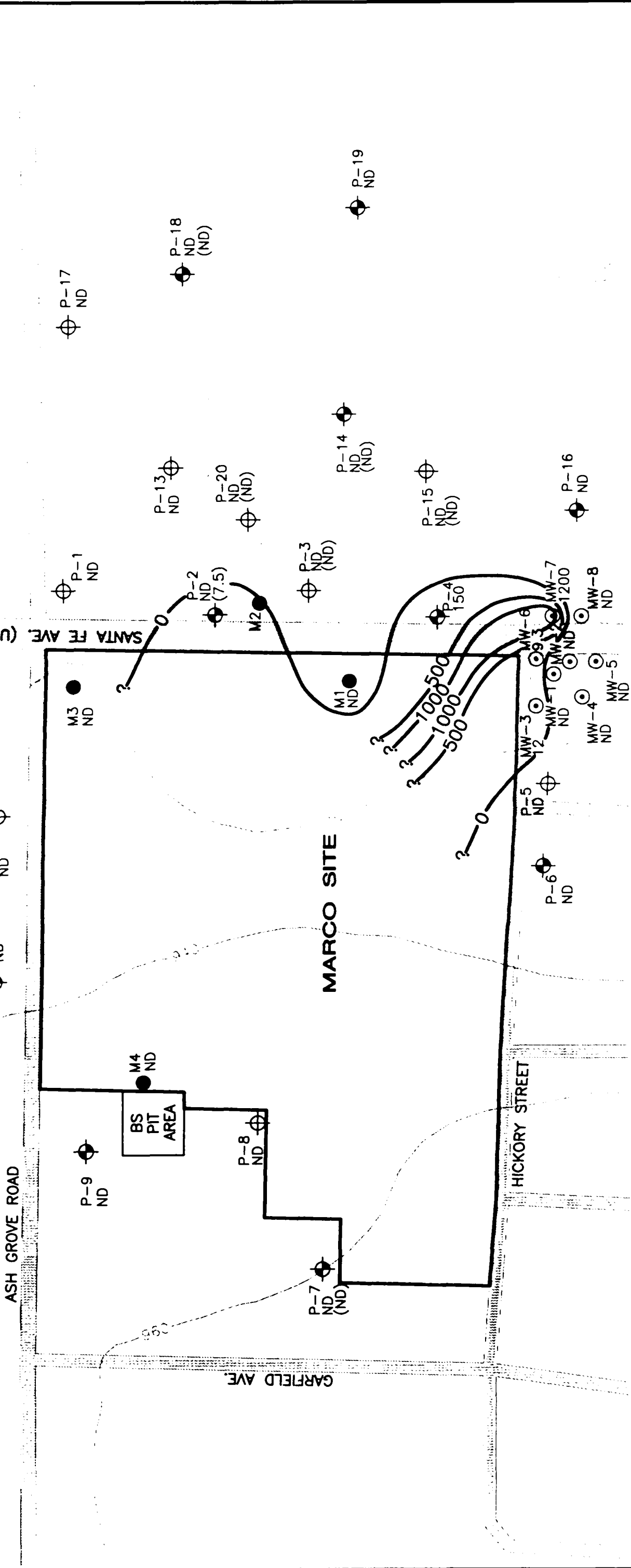
TITLE <b>GROUNDWATER ETHYLBENZENE ISOCONCENTRATION MAP DECEMBER 1997</b>			
DRAWN	DB	DATE	JAN. 1998
CHECKED	MJK	SCALE	AS SHOWN
REVIEWED	RSM	FILE NO	2300B018
		JOB NO	973-2300.7
		DWG. NO/REV. NO	B018
		FIGURE NO	21





NOTES:

- 1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
- 2. KDHE MONITOR WELL M2 NO LONGER EXISTS.
- 3. TERRACON MONITOR WELLS MW-1 THRU MW-8 ANALYTICAL RESULTS DATED SEPTEMBER 9, 1997.



LEGEND

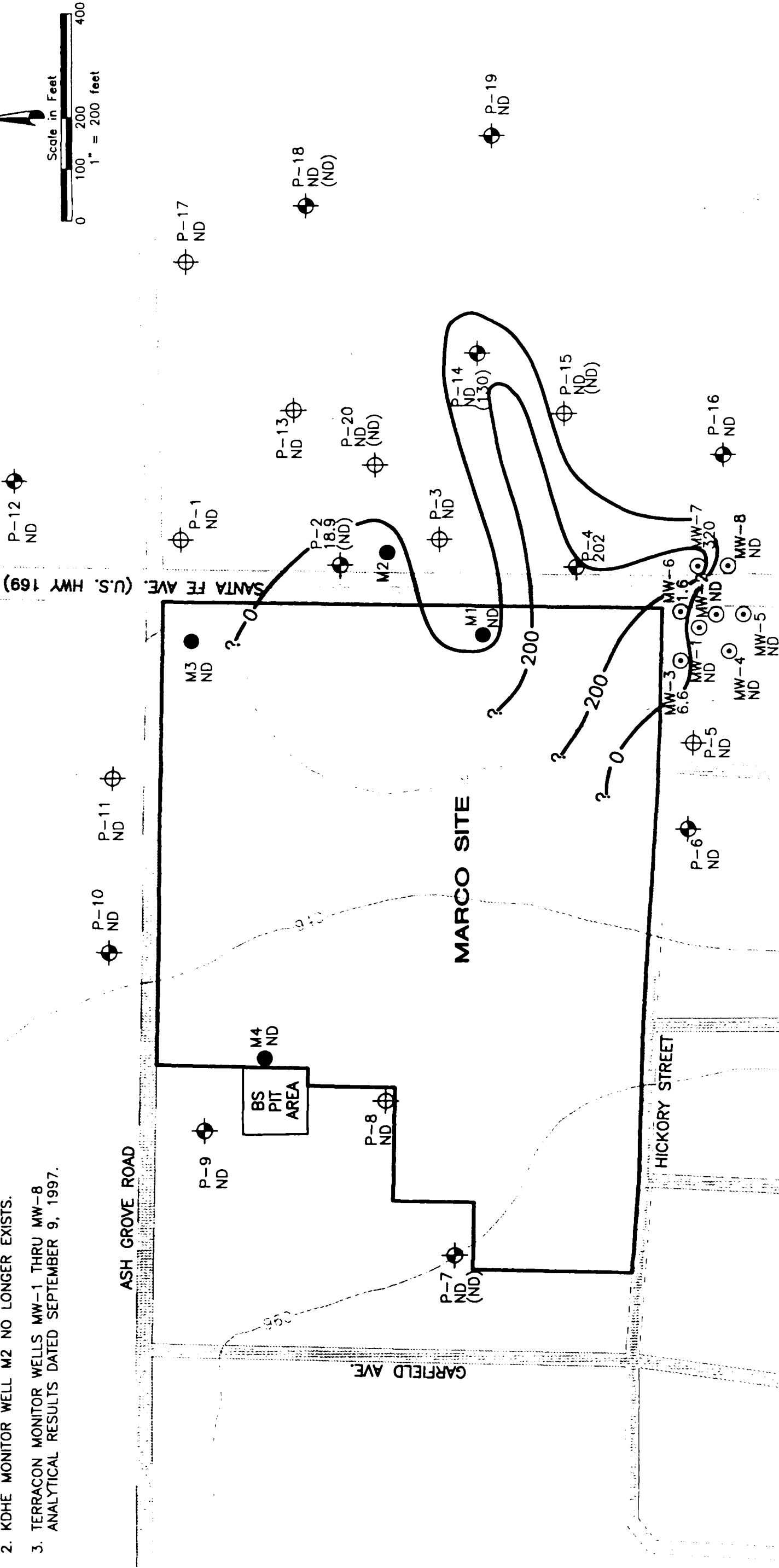
- ⊕ P-1 ND PROBE LOCATION XYLENE CONCENTRATION (Ug/L)
- ⊕ P-2 ND (7.5) PROBE AND 1" WELL LOCATION XYLENE CONCENTRATION (Ug/L)
- M3 ND PREVIOUS KDHE MONITOR WELL XYLENE CONCENTRATION (Ug/L)
- ⊙ MW-6 9.3 OTHER PREVIOUS MONITOR WELL XYLENE CONCENTRATION (Ug/L)
- 500 — XYLENE ISOCONCENTRATION CONTOUR (Ug/L) (DASHED WHERE INFERRED)
- ND NON-DETECT
- (7.5) PACE ANALYTICAL DUPLICATE SAMPLE RESULT

Golder Associates		Denver, Colorado		TITLE		GROUNDWATER XYLENE ISOCONCENTRATION MAP DECEMBER 1997	
CLIENT/PROJECT		KDHE MARCO INVESTIGATION		DRAWN	DB	DATE	JAN. 1998
				CHECKED	MJK	SCALE	AS SHOWN
				REVIEWED	RSM	FILE NO	2300B019
						JOB NO	973-2300.7
						DWG. NO./REV NO	B019
						FIGURE NO	22




NOTES:

1. TOPOGRAPHY AND CULTURAL FEATURE MAPPING PROVIDED BY AMERICAN DIGITAL CARTOGRAPHY INC. SOME SITE VICINITY RAILROAD SPURS HAVE BEEN REMOVED.
2. KDHE MONITOR WELL M2 NO LONGER EXISTS.
3. TERRACON MONITOR WELLS MW-1 THRU MW-8 ANALYTICAL RESULTS DATED SEPTEMBER 9, 1997.



⊕ P-1 ND	PROBE LOCATION NAPHTHALENE CONCENTRATION (Ug/L)	⊙ MW-6 1.6	OTHER PREVIOUS MONITOR WELL NAPHTHALENE CONCENTRATION (Ug/L)
⊕ P-2 18.9 (ND)	PROBE AND 1" WELL LOCATION NAPHTHALENE CONCENTRATION (Ug/L)	--- 200 ---	NAPHTHALENE ISOCONCENTRATION CONTOUR (Ug/L) (DASHED WHERE INFERRED)
● M3 ND	PREVIOUS KDHE MONITOR WELL NAPHTHALENE CONCENTRATION (Ug/L)	ND	NON-DETECT
		(130)	PAGE ANALYTICAL DUPLICATE SAMPLE RESULT

LEGEND

 <b>Gold Associates</b> Denver, Colorado		TITLE <b>GROUNDWATER NAPHTHALENE ISOCONCENTRATION MAP DECEMBER 1997</b>	
CLIENT/PROJECT <b>KDHE MARCO INVESTIGATION</b>		DRAWN MJK	DATE JAN. 1998
		CHECKED RSM	SCALE AS SHOWN
		REVIEWED	FIGURE NO 2300B020
		JOB NO 973-2300.7	FIGURE NO 23



**APPENDIX A**  
**EXCERPTS FROM 1987 KDHE REPORT**

1

2

3

TABLE 3-4  
MID AMERICAN REFINERY

WELL INFORMATION

Well Alias	Date	Static Water Level	Top of Casing	Total Depth	Screen Interval	Top of Casing Elevation	Ground Elevation
M1	11/06/86 01/29/87	4.75' 5.00'	1.71'	25.0'	15'-25'	917.155'	915.29'
M2	11/06/86 01/29/87	3.54' 3.69'	1.92'	25.0'	15'-25'	915.29'	913.27'
M3	11/06/86 01/29/87	3.83' 3.79'	2.48'	27.5'	17.5'- 27.5'	917.11'	914.35'
M4	11/06/86 01/29/87	5.00' 5.71'	0.75'	16'	11'-15'	941.385'	940.415'
FCrude	11/07/86	3.35'	2.79'	12.67'	7.67'- 12.67'	NA	NA
AGrove	11/06/86	2.63'	1.71'	22.04'	NA	NA	NA





KEY TO CHEMICAL ANALYSIS SUMMARY

UNITS:

Ug/l (ppb) - Parts per billion  
Mg/kg(ppm) - Milligrams per Kilogram  
Mg/l (ppm) - Parts per million

MEDIUM:

GW - Groundwater Sample  
SW - Surface Water Sample  
SOIL - Soil Sample  
SED - Sediment Sample  
SLDG - Sludge Sample

TYPE:

KNL - Kansas Notification Level  
KAL - Kansas Action Level  
CDC - Centers for Disease Control

OTHERS:

ND - Not Detected  
NA - Not Analyzed  
D - Detected  
\* - Many Petroleum Type Hydrocarbons Present  
# - Trace Levels of Petroleum Type Hydrocarbons Present







SITE NAME: MID AMERICA REFINERY  
SITE LOCATION: CLAWATE, KS

## Summary of Acid Extractable Analysis

[illegible]



SITE NAME: MID AMERICA REFINERY  
SITE LOCATION: CUMMITE, KS

MICROGRAMS/LITER (UG/L) (17B)

## Summary of Base Neutral Analysis

MG/KG

[illegible]

—

—



SITE NAME: MID AMERICA REFINERY  
SITE LOCATION: CLAWATE, KS

[illegible]

—

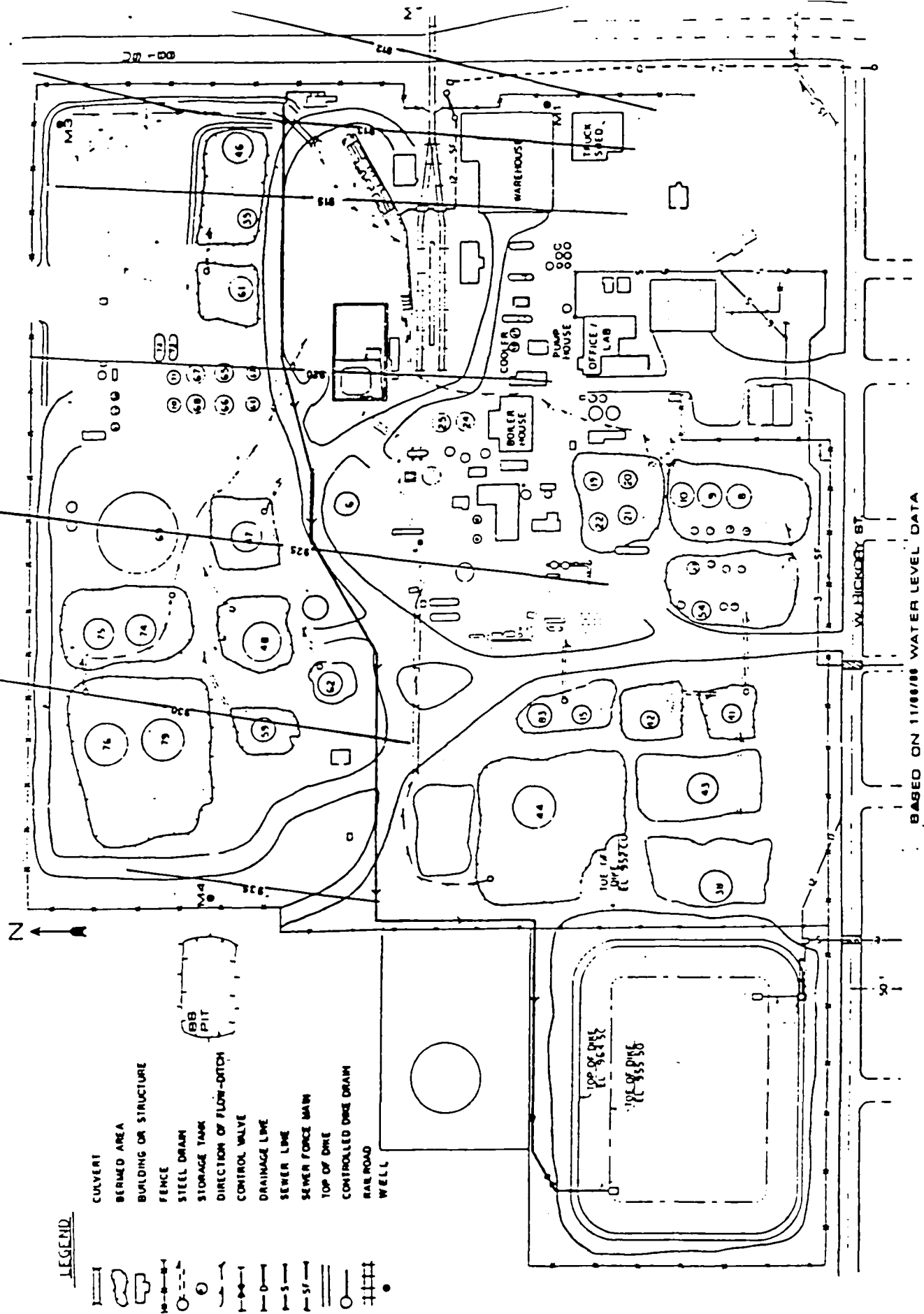
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# WILD AMERICA REFINERY POTENTIOMETRIC SURFACE MAP

MAP 4



## LEGEND

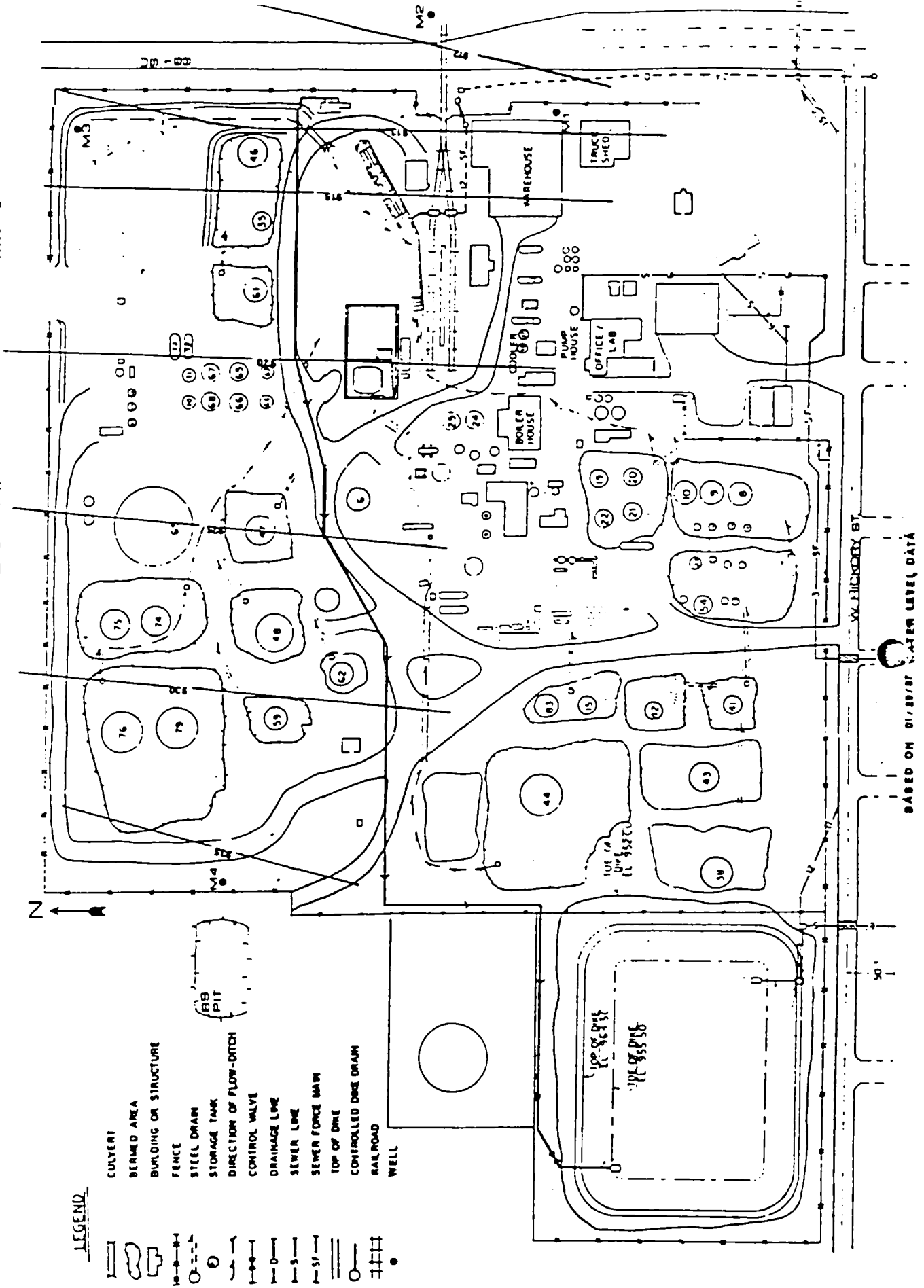
- CULVERT
- BERMED AREA
- BUILDING OR STRUCTURE
- FENCE
- STEEL DRAIN
- STORAGE TANK
- DIRECTION OF FLOW-OPTION
- CONTROL VALVE
- DRAINAGE LINE
- SEWER LINE
- SEWER FORCE MAIN
- TOP OF DNE
- CONTROLLED DNE DRAIN
- RAIL ROAD
- WELL

BASED ON 11/18/88 WATER LEVEL DATA



# MID AMERICA REFINERY POTENTIOMETRIC SURFACE MAP

MAP 5



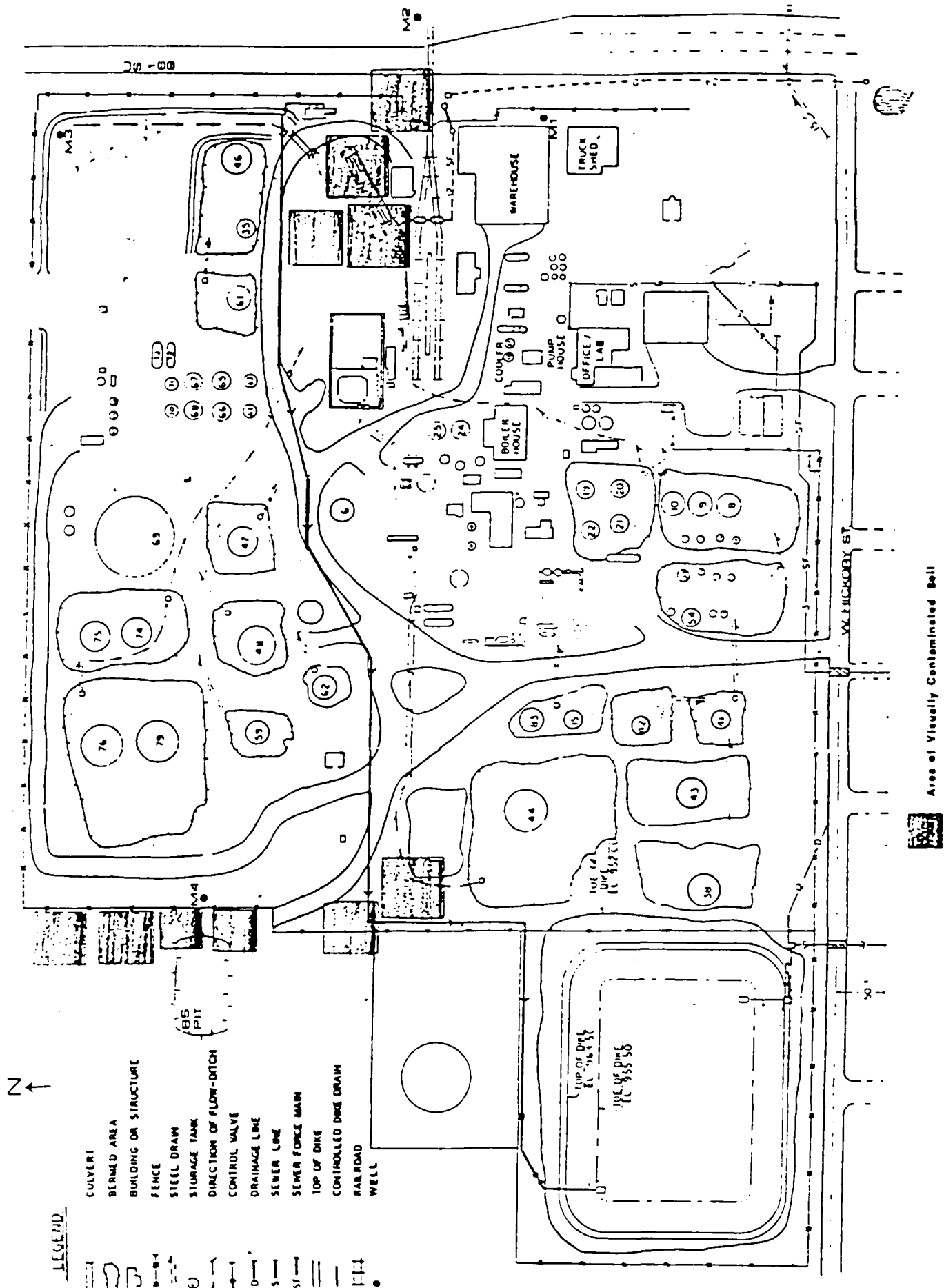




# MID AMERICA REFINERY

MAP 7

## CONTAMINATED SOIL MAP



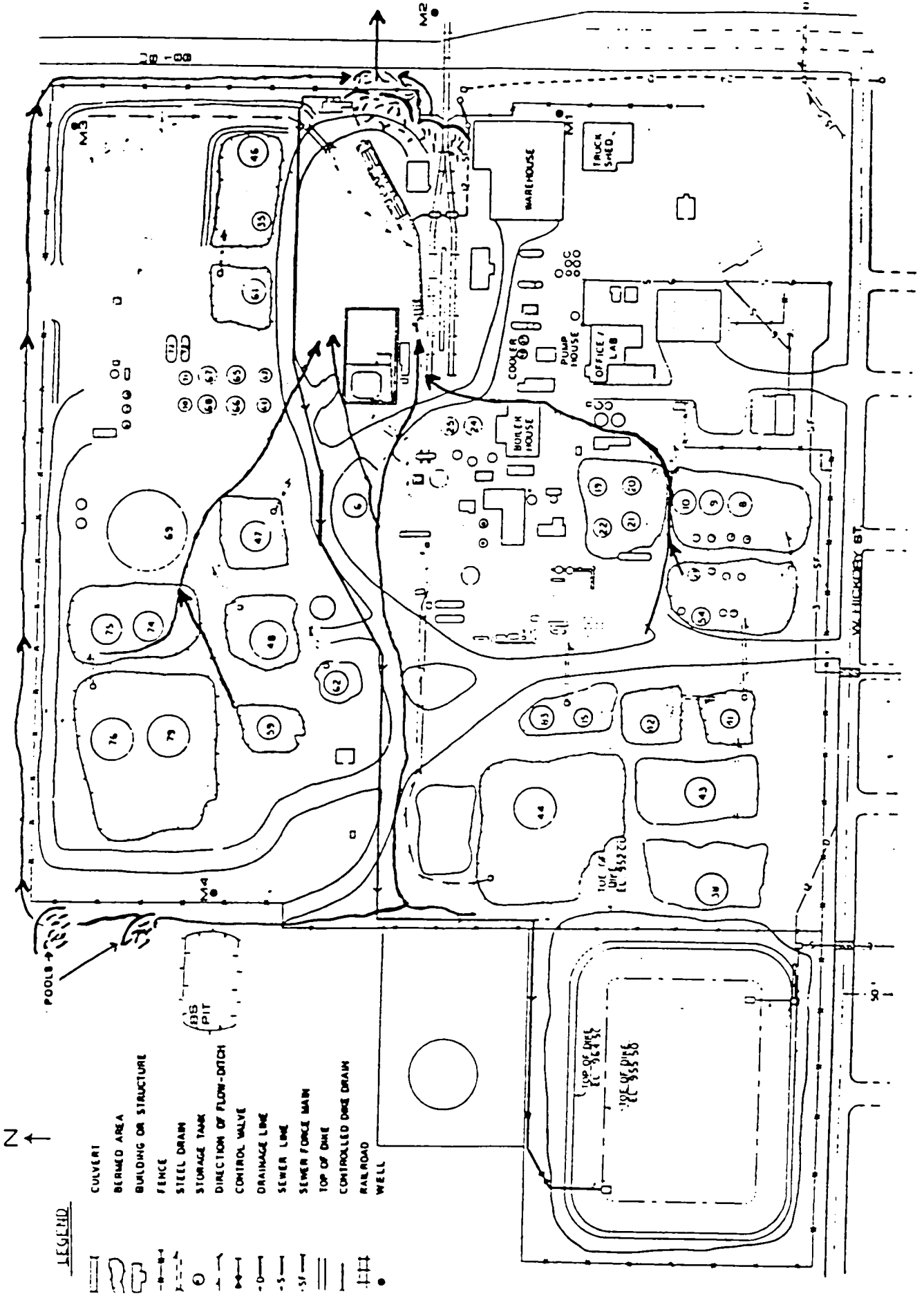
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—

# MID AMERICA REFINERY

MAP 8

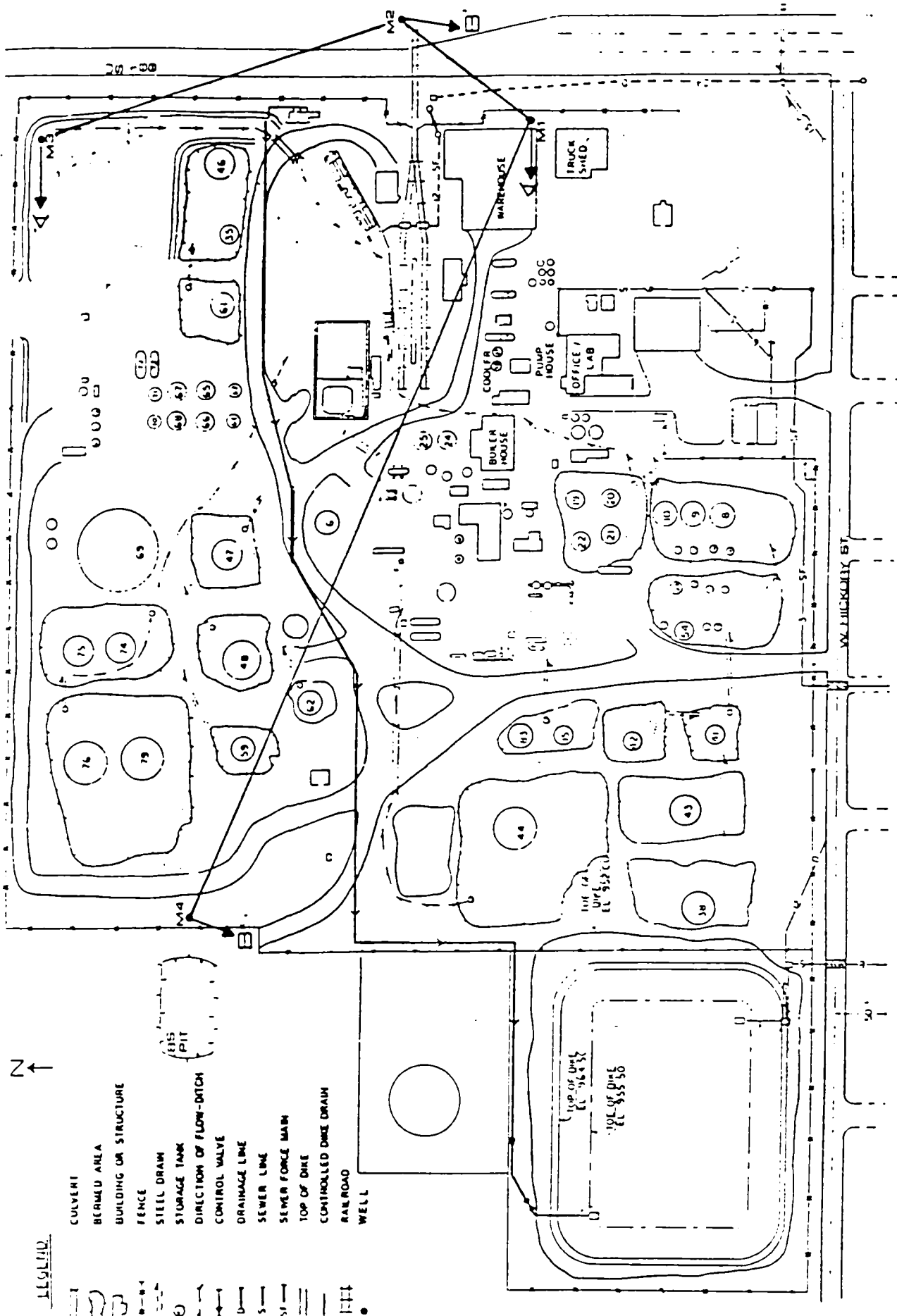
SURFACE WATER DRAINAGE



—

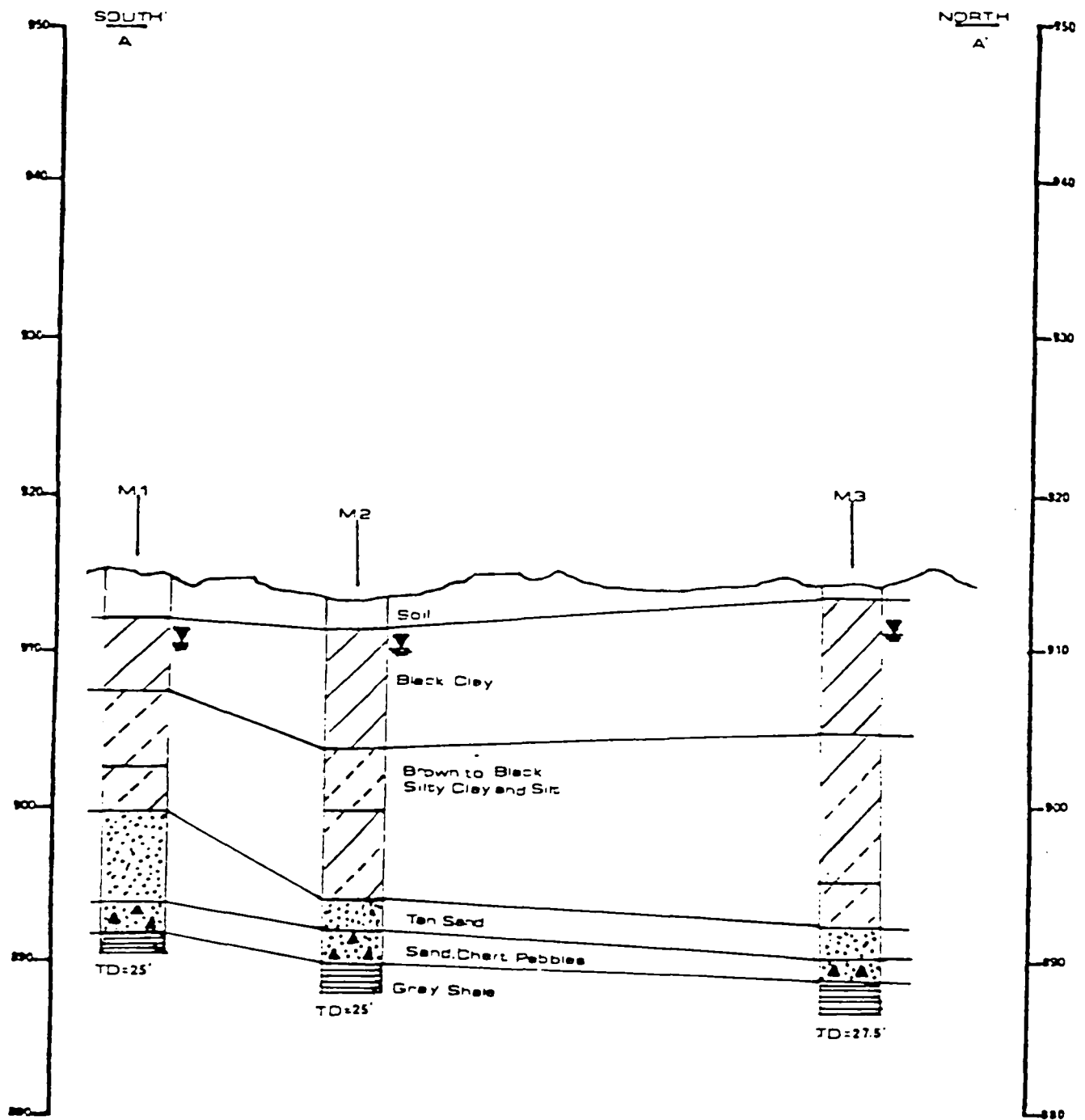
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5-3111-3





## GEOLOGIC CROSS SECTION A - A'



HORIZONTAL SCALE 1"=125'

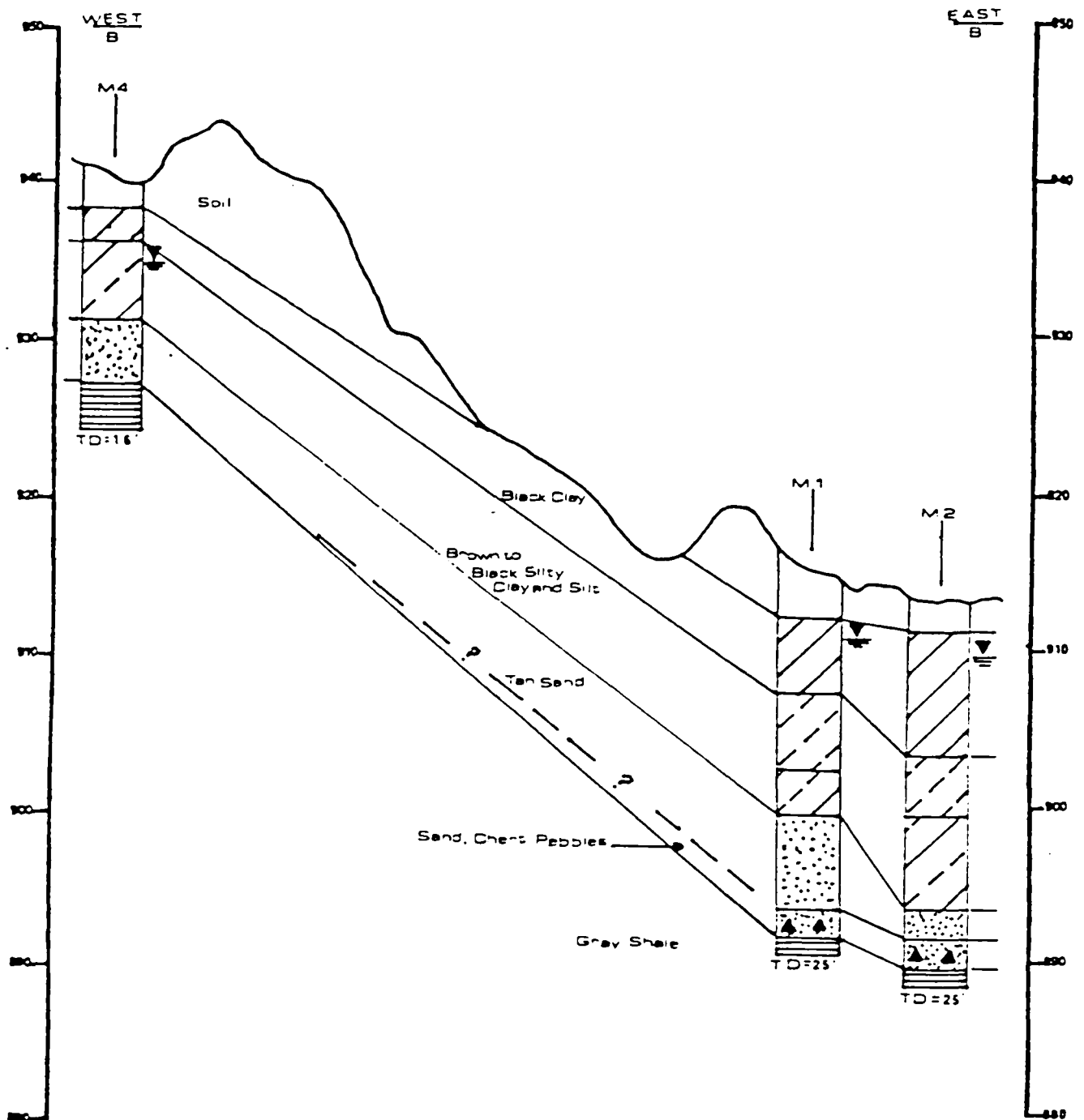
VERTICAL SCALE 1"=10'

PIEZOMETRIC ELEVATIONS 01-29-87





# GEOLOGIC CROSS SECTION B-B'



HORIZONTAL SCALE 1"=225'

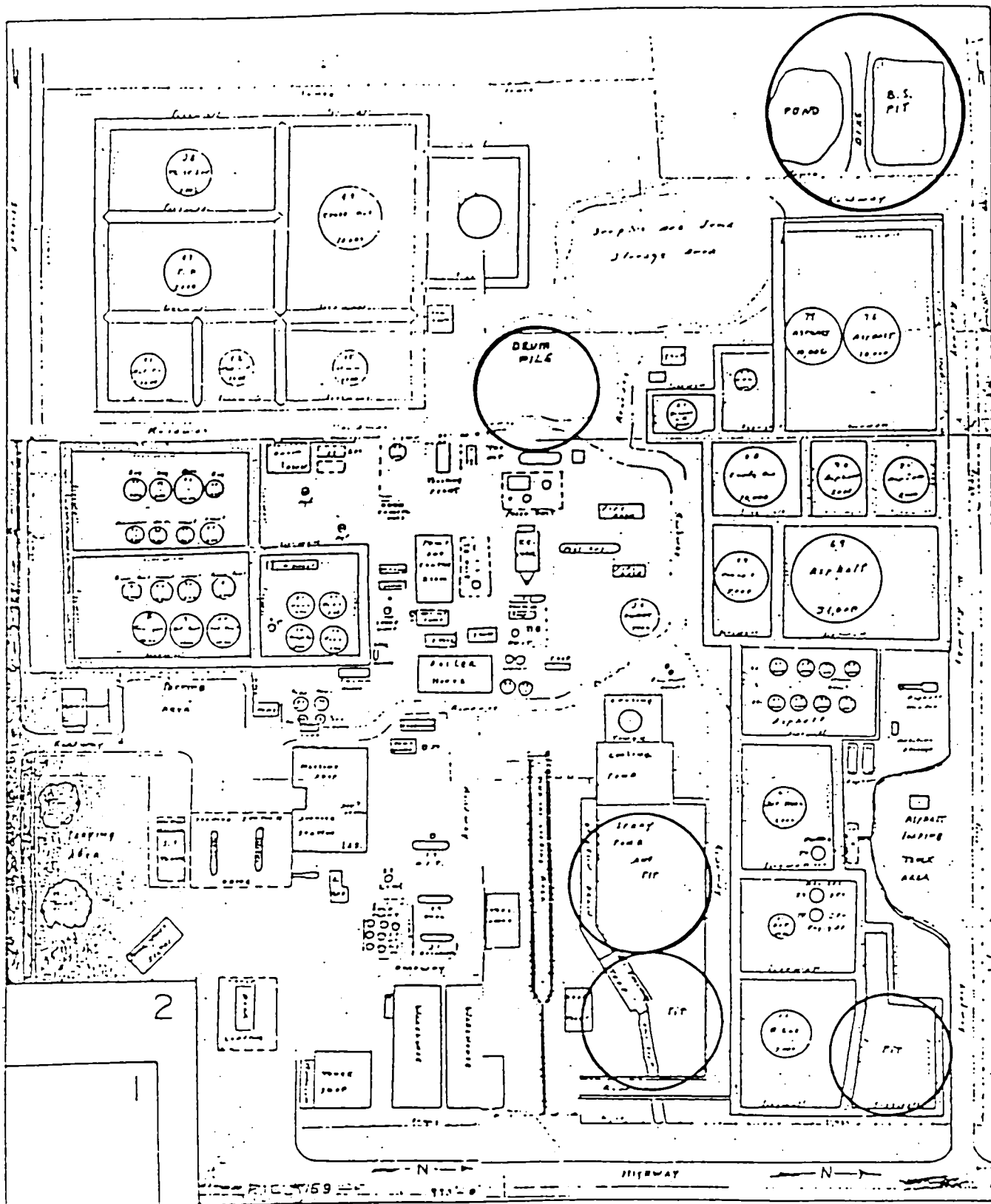
VERTICAL SCALE 1"=10'

PIEZOMETRIC ELEVATIONS 01-28-B7

KDHE

PLB





MID - AMERICAN REFINERY PLANT SKETCH

13th Feb. 1955



SUPPORT ZONE - Area where command post will be located.  
 CONTAMINATION REDUCTION ZONE - Area of decontamination.  
 EXCLUSION ZONE - Area(s) of alleged contamination.

—

—

# DRILLING FORM

PROJECT SITE Mid America Refinery

LEGAL LOCATION SE NE SE 17-27S-R18E

WELL ALIAS M1 DATE 09/25/86

DRILLER KDHE - Jack Slade

LOGGED BY Bill Thornton

DRILLING METHOD Solid stem auger HOLE SIZE 4 inch

CASING DETAILS 2 inch threaded flush joint PVC casing from 0' - 15'

ROUTING DETAILS cement grout 0-13 feet bentonite 13-14

WELL EVACUATION DETAILS pumped out 5 casing volumes before sample  
was taken

S.L.ELEV. 915.29

STATIC WATER LEVEL 5.0' on 1/29/87

SCREENED INTERVALS 15' - 25'



M /  
LITHOLOGY

	Casing	Log	Description	Remarks
			0 top soil, with fill	
ment out			5 brown to black clay	hydrocarbons present HNU 1 ppm
			10 orange, brown silt, limonite motting	
ntonite			15 dark grey silty sandy clay	
avel			20 tan, brown sand	
			coarse sand with chert pebbles	
			25 gray shale	





County NEOSHO Section SE 17 Township 27 S Range 15 E

Distance and direction from nearest town or city street address of well if located within city?

CHANCE - MID AMERICAN REFINERY

MI

WATER WELL OWNER: KDHE

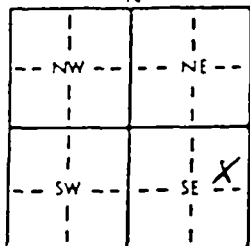
RR#, St. Address, Box #:

City, State, ZIP Code:

Board of Agriculture, Division of Water Resources

Application Number:

LOCATE WELL'S LOCATION WITH  
AN "X" IN SECTION BOX:



DEPTH OF COMPLETED WELL: 25 ft. ELEVATION: 796 117-155

Depth(s) Groundwater Encountered 1. 6 ft. 2. 22 ft. 3. \_\_\_\_\_ ft.

WELL'S STATIC WATER LEVEL 5.00 ft. below land surface measured on mo/day/yr 11/27/87

Pump test data: Well water was \_\_\_\_\_ ft. after \_\_\_\_\_ hours pumping \_\_\_\_\_ gpm

Est. Yield \_\_\_\_\_ gpm: Well water was \_\_\_\_\_ ft. after \_\_\_\_\_ hours pumping \_\_\_\_\_ gpm

Bore Hole Diameter: 4 in. to 25 ft. and \_\_\_\_\_ in. to \_\_\_\_\_ ft.

WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well

1 Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)

2 Irrigation 4 Industrial 7 Lawn and garden only 10 Observation well

Was a chemical/bacteriological sample submitted to Department? Yes X No \_\_\_\_\_ If yes, mo/day/yr sample was submitted 10/2/86 Water Well Disinfected? Yes \_\_\_\_\_ No (X)

5 TYPE OF BLANK CASING USED:

1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued \_\_\_\_\_ Clamped \_\_\_\_\_

2 PVC 4 ABS 7 Fiberglass \_\_\_\_\_ Threaded \_\_\_\_\_

Blank casing diameter 2 in. to 15 ft. Dia. \_\_\_\_\_ in. to \_\_\_\_\_ ft. Dia. \_\_\_\_\_ in. to \_\_\_\_\_ ft.

Casing height above land surface 1.7 in. weight \_\_\_\_\_ lbs./ft. Wall thickness or gauge No. \_\_\_\_\_

TYPE OF SCREEN OR PERFORATION MATERIAL:

1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 10 Asbestos-cement

2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 11 Other (specify) \_\_\_\_\_

SCREEN OR PERFORATION OPENINGS ARE:

1 Continuous slot 3 Mill slot 5 Gauzed wrapped 8 Saw cut 11 None (open hole)

2 Louvered shutter 4 Key punched 6 Wire wrapped 9 Drilled holes

SCREEN-PERFORATED INTERVALS: From 15 ft. to 25 ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

GRAVEL PACK INTERVALS: From 14 ft. to 25 ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

GROUT MATERIAL:

1 Neat cement 2 Cement grout 3 Bentonite 4 Other \_\_\_\_\_

Grout intervals: From 0 ft. to 10 ft. From 13 ft. to 14 ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

What is the nearest source of possible contamination:

1 Septic tank 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well

2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well

3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage 16 Other (specify below)

Direction from well? N How many feet? 240 Oil Separator

FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	3	Top soil, organic matter with fill			
3	7	dark clay, hydrocarbons present			
7	8	black to brown clay			
8	13	orange brown silt, limonite mottling			
13	16	dark grey sandy clay			
16	22	silt to fine tan-brown sand			
22	24	Coarse sand with chert pebbles			
24	25	grey shale			

CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/yr) 09/23/86 and this record is true to the best of my knowledge and belief. Kans.

Water Well Contractor's License No. \_\_\_\_\_ This Water Well Record was completed on (mo/day/yr) 10/29/86

for the business name of KDHE by (signature) [Signature]

INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Office of Oil Field and Environmental Geology, Regulation and Permitting Section, Topeka, Kansas 66620-7500. Telephone 913-862-5350. Send one to WATER WELL OWNER and retain one for your records.



# DRILLING FORM

SUBJECT SITE Mid America Refinery

LEGAL LOCATION NW NW SW 16-27S-R18E

WELL ALIAS M2 . DATE 09/25/86

DRILLER KDHE - Jack Slade LOGGED BY Rick Bean

DRILLING METHOD solid stem auger HOLE SIZE 4 inch

CASING DETAILS 2 inch threaded flush joint PVC casing from 0' - 15'

ROUTING DETAILS Cement grout 0-13 feet bentonite 13-14


WELL EVACUATION DETAILS pumped out 5 casing volumes before sample was taken

W.L.ELEV. 913.27 STATIC WATER LEVEL 3.69' on 1/29/87

CRENNED INTERVALS 15'-25'



M2  
LITHOLOGY

Casing	Log	Description	Remarks
cement grout		<div>0</div> <div>top soil, with fill</div> <div>5</div> <div>brown to black clay</div> <div>10</div> <div>brown to black silty clay</div> <div>15</div> <div>brown sand and clay</div> <div>20</div> <div>reddish brown sand chert pebbles and sand dark grey shale</div> <div>25</div>	HNU - 0 ppm
bentonite			
gravel			
sk			









# DRILLING FORM

PROJECT SITE Mid America Refinery

LEGAL LOCATION NE NE SE 17-27S-18E

WELL ALIAS M3 DATE 09/25/86

DRILLER KDHE - Jack Slade LOGGED BY Rick Bean

DRILLING METHOD solid stem auger HOLE SIZE 4 inch

CASING DETAILS 2 inch threaded flush joint PVC casing from 0' - 17.4'

GROUTING DETAILS cement grout 0-10 feet bentonite 15'-16.4'

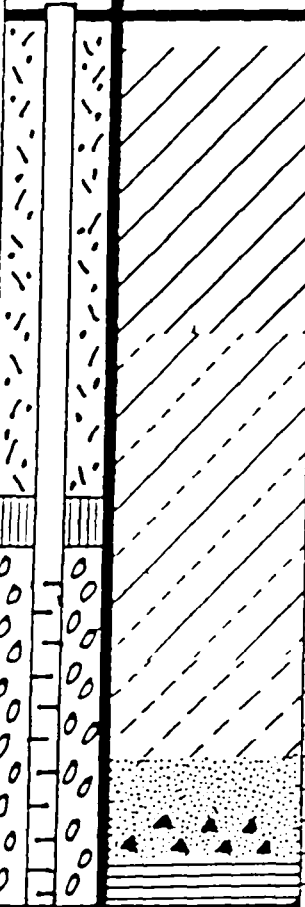
WELL EVACUATION DETAILS pumped out 5 casing volumes before sample was taken

G.L.ELEV. 914.35 STATIC WATER LEVEL 3.79' on 1/29/87

SCREENED INTERVALS 17.4' - 27.4'



M3  
LITHOLOGY

Casing	Log	Description	Remarks
cement grout		<div>0 top soil</div> <div>5 black, brown to grey clay</div> <div>10</div> <div>15 brown sandy- silty clay</div> <div>20 brown silt</div> <div>25 brown sand coarse sand and chert pebbles grey shale</div>	HNU - 0 ppm
bentonite			
gravel			
		30	



**LOCATION OF WATER WELL:**

County	Fraction	Section Number	Township Number	Range Number
Haskell	N.E. v. N.E. v. S.E.	17	T. 27	R. 15 E.W.

Distance and direction from nearest town or city street address of well if located within city?  
**Chouteau - Mid American Refinery (M3)**

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**WATER WELL OWNER:** KDHE  
RR#, St Address, Box # :  
City, State, ZIP Code :

**Board of Agriculture, Division of Water Resources**  
Application Number \_\_\_\_\_

---

**LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:**

**DEPTH OF COMPLETED WELL:** 27.4 ft. **ELEVATION:** 919.88-100

Depth(s) Groundwater Encountered 1. 13 ft. 2. ft. 3. ft.

**WELL'S STATIC WATER LEVEL:** 3.83 ft. below land surface measured on mo/day/yr 11/06/86

Pump test data: Well water was \_\_\_\_\_ ft. after \_\_\_\_\_ hours pumping \_\_\_\_\_ gpm

Est. Yield \_\_\_\_\_ gpm: Well water was \_\_\_\_\_ ft. after \_\_\_\_\_ hours pumping \_\_\_\_\_ gpm

Bore Hole Diameter .4 in. to 27.4 in. and \_\_\_\_\_ in. to \_\_\_\_\_ in.

**WELL WATER TO BE USED AS:**

1 Domestic	3 Feedlot	6 Oil field water supply	9 Dewatering	12 Other (Specify below)
2 Irrigation	4 Industrial	7 Lawn and garden only	10 Observation well	

Was a chemical/bacteriological sample submitted to Department? Yes \_\_\_\_\_ No \_\_\_\_\_. If yes, mo/day/yr sample was submitted \_\_\_\_\_  
Water Well Disinfected? Yes \_\_\_\_\_ No \_\_\_\_\_

---

**TYPE OF BLANK CASING USED:**

1 Steel	3 RMP (SR)	6 Asbestos-Cement	9 Other (specify below)
2 PVC	4 ABS	7 Fiberglass	

Casing diameter \_\_\_\_\_ in. to 17.4 ft. Dia \_\_\_\_\_ in. to \_\_\_\_\_ ft. Dia \_\_\_\_\_ in. to \_\_\_\_\_ ft.  
Casing height above land surface \_\_\_\_\_ in., weight \_\_\_\_\_ lbs./ft. Wall thickness or gauge No. \_\_\_\_\_

**TYPE OF SCREEN OR PERFORATION MATERIAL:**

1 Steel	3 Stainless steel	5 Fiberglass	8 RMP (SR)	11 Other (specify)
2 Brass	4 Galvanized steel	6 Concrete tile	9 ABS	12 None used (open hole)

**SCREEN OR PERFORATION OPENINGS ARE:**

1 Continuous slot	3 Mill slot	5 Gauzed wrapped	8 Saw cut	11 None (open hole)
2 Louvered shutter	4 Key punched	6 Wire wrapped	9 Drilled holes	

**SCREEN-PERFORATED INTERVALS:** From 17.4 ft. to 27.4 ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

**GRAVEL PACK INTERVALS:** From 16.4 ft. to 27.4 ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

---

**GROUT MATERIAL:**

1 Neat cement	2 Cement grout	3 Bentonite	4 Other
---------------	----------------	-------------	---------

Put intervals: From \_\_\_\_\_ ft. to 16.4 ft. From 15 ft. to 16.4 ft. From \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

What is the nearest source of possible contamination?

1 Septic tank	4 Lateral lines	7 Pit privy	10 Livestock pens	14 Abandoned water well
2 Sewer lines	5 Cess pool	8 Sewage lagoon	11 Fuel storage	15 Oil well/Gas well
3 Watertight sewer lines	6 Seepage pit	9 Feedyard	12 Fertilizer storage	16 Other (specify below)

Direction from well? S-SW  
How many feet? 300'

---

**LITHOLOGIC LOG**

FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	1	Top Soil			
1	5	black to dark brown clay			
5	10	grey clay			
10	16	brown clay & silt			
16	20	fine to medium clayey sand			
20	23	brown silt			
23	24	medium brown sandstone			
24	26	coarse sand & chert pebbles			
26	27.5	gray shale - TD			

---

**CONTRACTOR'S OR LANDOWNER'S CERTIFICATION:** This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 9/24/86 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. \_\_\_\_\_ This Water Well Record was completed on (mo/day/yr) 10/8/86 by (signature) [Signature]

**INSTRUCTIONS:** Use typewriter or ball point pen. PLEASE PRESS FIRMLY AND PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Office of Oil Field and Environmental Geology, Regulation and Permitting Section, Topeka, Kansas 66620-7500. Telephone 913-862-9360. Send one to WATER WELL OWNER and retain one for your records.



# DRILLING FORM

PROJECT SITE Mid America Refinery

LEGAL LOCATION NW NE SE 17-27S-18E

WELL ALIAS M4 - DATE 09/25/86

DRILLER KDHE - Jack Slade LOGGED BY Rick Bean

DRILLING METHOD solid stem auger HOLE SIZE 4 inch

CASING DETAILS 2 inch threaded flush joint PVC casing from 0' to 11'

GROUTING DETAILS cement grout from 0' - 9' bentonite 9' - 10'

WELL EVACUATION DETAILS pumped out 5 casing volumes before sample was taken

S.L.ELEV. 940.415' STATIC WATER LEVEL 5.71' on 1/29/87

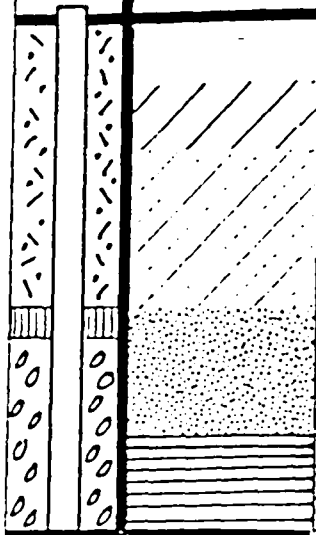
SCREENED INTERVALS 10'-16'

—

—



M4  
LITHOLOGY

Casing	Log	Description	Remarks
<div>cement grout</div> <div>bentonite</div> <div>gravel pack</div>		<div>0</div> <div>top soil</div> <div>dark black clay</div> <div>5</div> <div>brown sandy clay</div> <div>10</div> <div>tan sand</div> <div>15</div> <div>grey shale</div>	<div>HNU - 0 ppm</div>
		20	



to WATER WELL OWNER and retain one for your records;



**APPENDIX B**

**SUPPLEMENTAL SUPPORTING DATA**



**APPENDIX B-1**

**EXCERPTS FROM LACON 1997B REPORT**





November 10, 1997

Ms. Leticia Arzate  
Kansas Department of Health and Environment  
Forbes Field, Building 740  
Topeka, Kansas 66620-0001

# Terracon

ENVIRONMENTAL, INC.

2111 West Harry Street  
Wichita, Kansas 67213  
(316) 262-0281 Fax: (316) 262-6097

John F. Hanwell, P.E.  
S. Randy Alewine, P.E.  
Douglas A. Aldrich, P.E.  
Kenneth C. Wallace  
Michael J. Wilcox

RE: Monitoring Report #2, August through October, 1997  
Fina #3058  
1125 N. Santa Fe  
Chanute, Kansas  
KDHE Project code U3-067-264  
Project No. 52975059

COPY SENT TO DISTRICT OFFICE

Dear Ms. Arzate:

Terracon Environmental, Inc. (Terracon) has completed groundwater sampling event #2 at the above-referenced site in general accordance with our Proposal dated July 8, 1997. Field work was conducted on September 9, 1997. The following information is submitted for your review.

- Historical Groundwater Elevations (Table 1)
- Historical Groundwater Laboratory Results (Table 2)
- Groundwater Contour Map (Figure 1)
- Total BTEX Isoconcentration Map (Figure 2)
- Field Records
- Laboratory Reports

## RECEIVED

NOV 12 1997

### 1.0 RESULTS

BUREAU OF  
ENVIRONMENTAL  
REMEDATION

As indicated in Table 1, groundwater levels declined about 0.5 foot from July 1997 to September 1997. Groundwater flow direction is generally to the east (Figure 1).

Total BTEX concentrations detected during the September 1997 sampling event generally increased from the July 1997 sampling event. Benzene concentrations were detected in samples obtained from MW-2, MW-3, MW-6, and MW-7. Benzene concentrations in excess of the benzene MCL (5 µg/L) were detected in MW-3 and MW-7.

Ethylbenzene was detected in MW-3 and MW-7. Ethylbenzene concentrations in excess of the ethylbenzene MCL (680 µg/L) were detected in MW-7.

Xylene was detected in MW-3, MW-6, and MW-7 and in excess of the xylene MCL (440 µg/L) in MW-7.

1,2-DCA was not detected in the groundwater samples analyzed.

Offices of The Terracon Companies, Inc.

Alaska ■ Arkansas ■ Colorado ■ Idaho ■ Illinois ■ Iowa ■ Kansas ■ Minnesota ■ Missouri ■ Montana ■ Nebraska ■ Nevada ■ New Mexico ■ Oklahoma ■ Tennessee ■ Texas ■ Utah ■ Wisconsin ■ Wyoming

Environmental Engineers and Scientists



Fina # 3058  
Project No. 52975059  
November 10, 1997  
Page 2

Terracon

MtBE was detected in MW-2, MW-5, and the Existing Well.

Naphthalene was detected in MW-3, MW-6, and MW-7 and above its MCL (143 µg/L) in MW-7.

Distribution of the impacted groundwater from the September 1997 sampling event appears to be consistent with previous sampling events.

The on-site 6-inch diameter Existing Well was observed to be located beneath a kerosene AST and does not have an expansion plug well cap or metal manhole lid. This well could provide a potential pathway for a surface release/spill from the AST to enter the subsurface. During the next monitoring event, Terracon recommends installing an expansion cap and manhole lid on this Existing Well.

Water generated from well purging activity was processed through a 55-gallon drum of activated carbon and the treated water discarded on the ground on-site.

We anticipate the next sampling event to occur in January 1998.

## 2.0 GENERAL COMMENTS

The results obtained represent conditions at the times and locations sampled. Sampling at different times and locations may yield different results.

Terracon appreciates the opportunity to provide environmental engineering services to KDHE and Fina Oil and Chemical Company. Should you have any questions concerning the above information or other aspects of this project, please contact us.

Sincerely,

TERRACON ENVIRONMENTAL, INC.

  
Michael Nash

Environmental Engineer

  
Kenneth C. Wallace, RG  
Sr. Project Manager

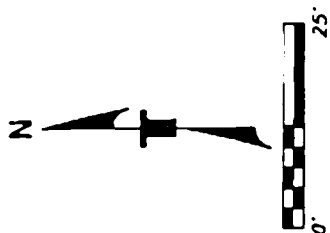
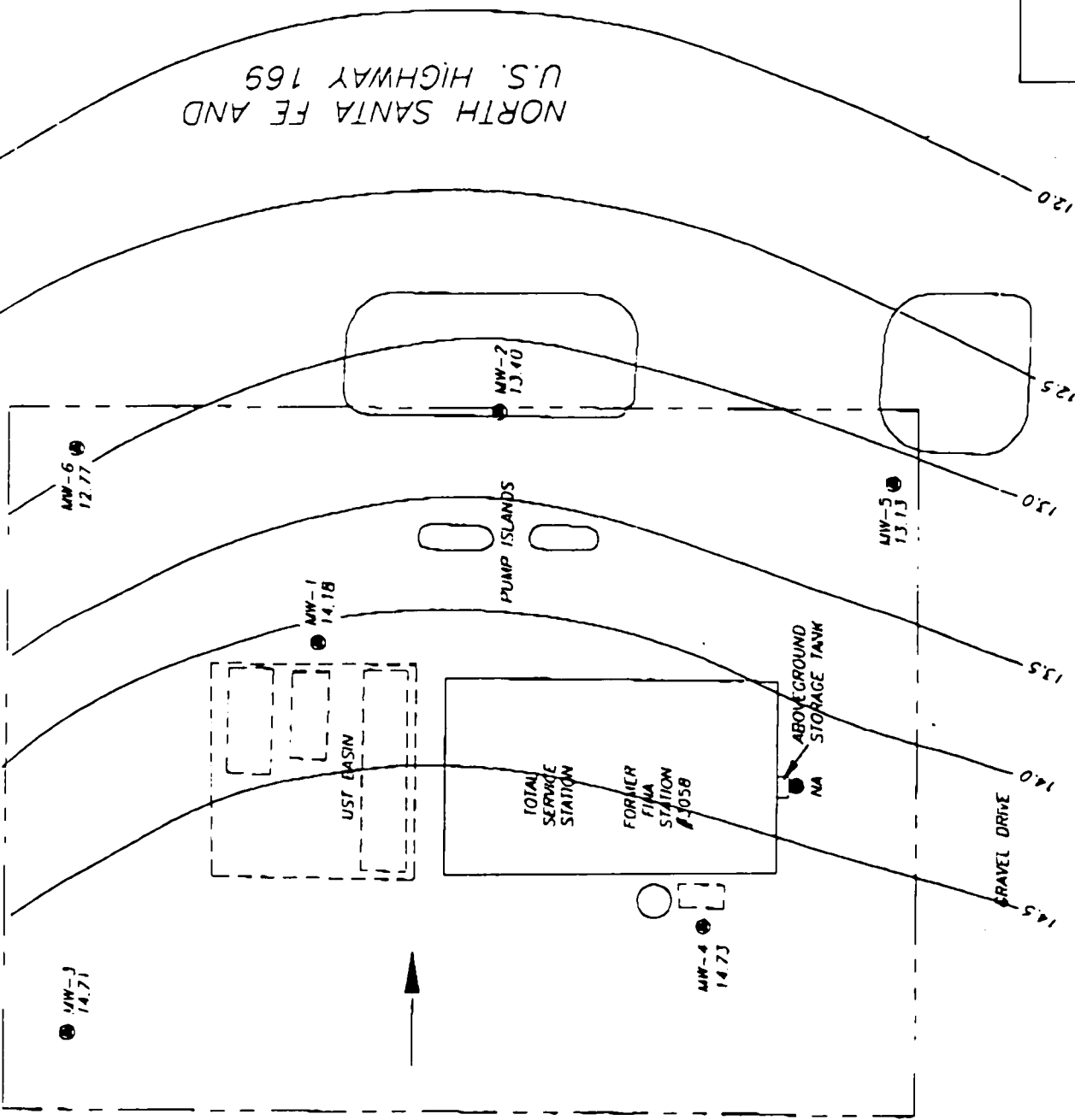
cc: Greg Ferris - Fina Oil and Chemical Company

n: \env\projects\1997\52975059\mnt#2.doc



HICKORY STREET

U.S. HIGHWAY 169



LEGEND

- MONITOR WELL
- EXISTING WELL
- PROPERTY LINE
- 12.77 GROUNDWATER ELEVATION (FL.)
- GROUNDWATER POTENTIOMETRIC CONTOUR LINE
- C.I. - 0.5 FL.
- GROUNDWATER FLOW DIRECTION

GROUNDWATER CONTOUR MAP  
FORMER FINA SERVICE STATION #3058  
1125 NORTH SANTA FE AVENUE  
CHANUTE, KANSAS

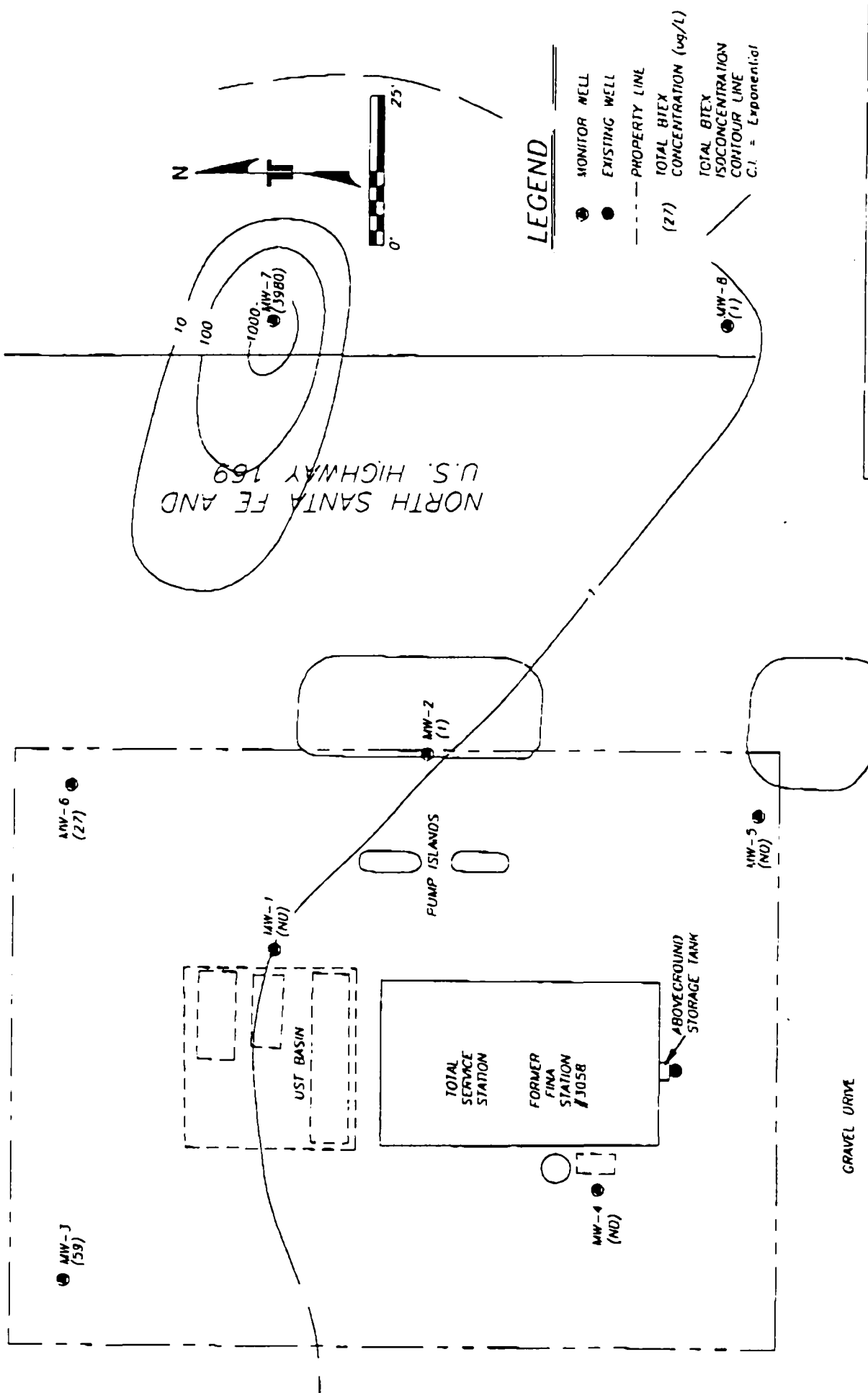
PROJECT NAME: KCW	PROJ # 529750
DRAWN BY: MEK	SCALE: SHOW
CHECKED BY: MEK	FN: 529750
APPROVED BY: DAA	DATE: 10/98
<b>Terracon</b> ENVIRONMENTAL, INC. 2111 W. Harry Street Wichita, Kansas 67213	

NOTE: CONTOURS ARE BASED ON INTERPOLATION BETWEEN DATA POINTS; ACTUAL CONDITIONS MAY VARY.  
CONTOURS EXTRAPOLATED BEYOND DATA POINTS ARE SUBJECTIVE AND DASHED WHERE INFERRED

DRAWING NO. Figure 1



HICKORY STREET



# LEGEND

- MONITOR WELL
- EXISTING WELL
- PROPERTY LINE
- (27) TOTAL BIEX CONCENTRATION (ug/L)
- (1) TOTAL BIEX ISOCONCENTRATION (ug/L)
- CONTOUR LINE
- C.I. = Exponential

TOTAL BIEX ISOCONCENTRATION MAP		PROJECT UNDER KCW	PROJ # 529750
FORMER FINA SERVICE STATION #3058		DESIGNED BY: MFK	SCALE: SHOW
1125 NORTH SANTA FE AVENUE		CHECKED BY: DAA	DATE: 10/9
CHAPULTEPEC, KANSAS		<b>Terracon</b> ENVIRONMENTAL, INC. 2111 W. Henry Street Wichita, Kansas 67213	

NOTE: CONTOURS ARE BASED ON INTERPOLATION BETWEEN DATA POINTS; ACTUAL CONDITIONS MAY VARY. CONTOURS EXTRAPOLATED BEYOND DATA POINTS ARE SUBJECTIVE AND DASHED WHERE INFORMED.





TABLE 2: HISTORICAL GROUNDWATER LABORATORY RESULTS									
LOCATION	DATE SAMPLED	BENZENE (ug/l)	TOLUENE (ug/l)	ETHYL BENZENE (ug/l)	XYLENE (ug/l)	TOTAL BTEX (ug/l)	1,2-DCA (ug/l)	MTBE (ug/l)	NAPH-THALENE (ug/l)
MW-1	8/14/95	ND(0.5)	ND(1)	ND(1)	ND(3)	ND	ND(1)	2.6	ND(0.5)
	7/17/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	ND(1)	ND(1)
	9/9/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	ND(1)	ND(1)
MW-2	9/14/95	31	ND(1)	5.6	ND(3)	37	ND(1)	15	ND(0.5)
	7/17/97	0.6	ND(1)	ND(1)	ND(1)	1	ND(1)	8.9	ND(1)
	9/9/97	0.7	ND(1)	ND(1)	ND(1)	1	ND(1)	15	ND(1)
MW-3	9/14/95	1.6	3.8	2.5	ND(3)	8	ND(1)	15	ND(0.5)
	7/17/97	5.4	5.8	ND(1)	1.7	13	ND(1)	1.2	1.2
	9/9/97	18	14	15	12	59	ND(1)	ND(1)	6.6
MW-4	9/14/95	ND(0.5)	ND(1)	ND(1)	ND(3)	ND	ND(1)	ND(1)	ND(0.5)
	7/17/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	1.9	ND(1)
	9/9/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	ND(1)	ND(1)



TABLE 2: HISTORICAL GROUNDWATER LABORATORY RESULTS										
LOCATION	DATE SAMPLED	BENZENE (ug/l)	TOLUENE (ug/l)	ETHYL BENZENE (ug/l)	XYLENE (ug/l)	TOTAL BTEX (ug/l)	1,2-DCA (ug/l)	MTBE (ug/l)	NAPH-THALENE (ug/l)	
MW-5	*9/14/95	ND(0.5)	ND(1)	ND(1)	ND(3)	ND	ND(1)	ND(1)	ND(0.5)	
	7/17/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	ND(1)	ND(1)	
	9/9/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	1.4	ND(1)	
MW-6	*9/14/95	2.7	20	ND(1)	5.8	29	ND(1)	ND(1)	0.58	
	7/17/97	13	20	ND(1)	4.1	37	ND(1)	14	2.1	
	9/9/97	3.2	14	ND(1)	9.3	27	ND(1)	ND(1)	1.6	
MW-7	*9/14/95	1200	490	1400	1400	4490	ND(25)	ND(25)	74	
	7/17/97	800	270	850	790	2710	ND(10)	ND(10)	250	
	9/9/97	1200	380	1200	1200	3980	ND(5)	ND(5)	320	
MW-8	*9/14/95	ND(0.5)	ND(1)	ND(1)	ND(3)	ND	ND(1)	ND(1)	ND(0.5)	
	7/17/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	ND(1)	ND(1)	
	9/9/97	ND(0.5)	1	ND(1)	ND(1)	1	ND(1)	ND(1)	ND(1)	



TABLE 2: HISTORICAL GROUNDWATER LABORATORY RESULTS									
LOCATION	DATE SAMPLED	BENZENE (ug/l)	TOLUENE (ug/l)	ETHYL BENZENE (ug/l)	XYLENE (ug/l)	TOTAL BTEX (ug/l)	1,2-DCA (ug/l)	MTBE (ug/l)	NAPH-THALENE (ug/l)
EXISTING WELL	9/14/95	ND(0.5)	ND(1)	ND(1)	ND(3)	ND	ND(1)	ND(1)	ND(0.5)
	7/17/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	1.2	ND(1)
	9/9/97	ND(0.5)	ND(1)	ND(1)	ND(1)	ND	ND(1)	1.9	ND(1)
KNL		0.5	100	68	44	NE	0.5	NE	NE
MCL		5	1000	680	440	NE	5	NE	143

ug/l = micrograms/liter, roughly equivalent to parts per billion

ND(X.Y) = not detected, detection limits in parenthesis

NA = not analyzed

KNL = Kansas Notification Level

MCL = KDE Maximum Contaminant Level

NE = Not Established

\* Information taken from Site Assessment Report prepared by Geraghty & Miller dated May 1996



Fina 3058

Terracon No. 52975059

TABLE 1: Historical Groundwater Elevations (Feet)					
Location	Date Measured	TOC Elevation <sup>1</sup>	DTP below TOC <sup>2</sup>	DTW below TOC <sup>2</sup>	GW Elevation
MW-1	*9/14/95	915.49		2.02	913.47
	7/17/97			0.91	914.58
	9/9/97			1.31	914.18
MW-2	*9/14/95	915.98		3.18	912.78
	7/17/97			2.18	913.78
	9/9/97			2.56	913.40
MW-3	*9/14/95	915.80		1.66	914.14
	7/17/97			1.29	914.51
	9/9/97			1.09	914.71
MW-4	*9/14/95	917.61		3.38	914.23
	7/17/97			1.98	915.63
	9/9/97			2.88	914.73
MW-5	*9/14/95	915.66		2.81	912.85
	7/17/97			1.74	913.92
	9/9/97			2.53	913.13





Fina 3058

Terracon No. 52975059

TABLE 1: Historical Groundwater Elevations (Feet)					
Location	Date Measured	TOC Elevation <sup>1</sup>	DTP below TOC <sup>2</sup>	DTW below TOC <sup>2</sup>	GW Elevation
MW-6	*9/14/95	915.82		3.31	912.51
	7/17/97			2.78	913.04
	9/9/97			3.05	912.77
MW-7	*9/14/95	914.75		3.87	910.88
	7/17/97			2.24	912.51
	9/9/97			2.86	911.89
MW-8	*9/14/95	913.70		2.89	910.81
	7/17/97			1.23	912.47
	9/9/97			1.84	911.86
EXISTING WELL	NA	NA	NA	NA	NA
	7/17/97			2.23	NA
	9/9/97			2.74	NA

## Notes:

1) Top of Casing (TOC) elevation determined by registered land surveyor and expressed as feet above mean sea level.

2) Depths to groundwater/product (DTW/DTP) determined using an CRS Hydrocarbon Interface Probe.

NA = Not Available

\* Information taken from Site Assessment Report prepared by Geraghty & Miller dated May 1996



**APPENDIX B-2**

**MAY 1996 KDHE GROUNDWATER SAMPLING RESULTS**





# KANSAS HEALTH & ENVIRONMENTAL LABORATORY

Department of Health and Environment

Forbes Field, Bldg. 740, Topeka, Kansas 66620



## REPORT OF ANALYSIS

MAY 14 1996

### ORGANIC CHEMISTRY BUREAU OF ENVIRONMENTAL REMEDIATION

Report To: TOM PETERSON-BER  
Address: FORBES FIELD, BLDG 740,  
TOPEKA, KS 66620

Lab Number: 604217VX  
Date Rec'd: 05/03/96  
Report Date: 05/10/96

Site ID No.:

Acct No:  
Site: MW-1 - MARCO, CHANUTE  
Collected By: KDHE S. STOVER/F. ARNWINE

Sample Type: WATER Program Code: EW  
No. Compositing: 0  
Depth: Date: 05/02/96 Time: 13:10

PRIORITY POLLUTANT VOLATILE ORGANIC COMPOUNDS	CONCENTRATION ( ug/L )	Analysis Date	EPA Method
Chloromethane	< 5.0	05/08/1996	624
Bromomethane	< 1.2	05/08/1996	624
Vinyl Chloride	< 0.8	05/08/1996	624
Chloroethane	< 3.7	05/08/1996	624
Dichloromethane	< 0.9	05/08/1996	624
1,1-Dichloroethylene	< 0.6	05/08/1996	624
1,1-Dichloroethane	< 0.6	05/08/1996	624
trans/cis 1,2-Dichloroethylene as trans	< 0.5	05/08/1996	624
Trichloromethane (THM)	< 0.5	05/08/1996	624
1,2-Dichloroethane	< 0.5	05/08/1996	624
1,1,1-Trichloroethane	< 0.6	05/08/1996	624
Tetrachloromethane	< 0.7	05/08/1996	624
Bromodichloromethane (THM)	< 0.5	05/08/1996	624
1,2-Dichloropropane	< 0.5	05/08/1996	624
trans 1,3-Dichloropropene	< 0.8	05/08/1996	624
Trichloroethylene	< 0.6	05/08/1996	624
Benzene	296	05/08/1996	624
Dibromochloromethane (THM)	< 0.7	05/08/1996	624
cis 1,3-Dichloropropene	< 0.9	05/08/1996	624
1,1,2-Trichloroethane	< 0.6	05/08/1996	624
Bromoform (THM)	< 1.5	05/08/1996	624
1,1,2,2-Tetrachloroethane	< 0.6	05/08/1996	624
Tetrachloroethylene	< 1.1	05/08/1996	624
Toluene	31.3	05/08/1996	624
Chlorobenzene	< 0.5	05/08/1996	624
Ethylbenzene	3.7	05/08/1996	624
Xylene	21.0	05/08/1996	624
1,3-Dichlorobenzene	< 1.0	05/08/1996	624
1,2-Dichlorobenzene	< 1.0	05/08/1996	624
1,4-Dichlorobenzene	< 1.0	05/08/1996	624

Comment: Many petroleum type hydrocarbons were indicated.

Chemist: Richard L. Pierce *RLP*

< - Not Detected at Indicated Level.

*not sample*

#### Environmental Laboratories

Inorganic Chemistry (913) 296-1657  
Organic Chemistry (913) 296-1647  
Radiochemistry (913) 296-1629  
Env. Microbiology (913) 296-0971

Roger H. Carlson, Ph.D., Director - (913) 296-1620  
Laboratory Information and Reporting - (913) 296-1627  
Laboratory Fax - (913) 296-1641

#### Health Laboratories

Diagnostic Micro. (913) 296-1636  
Neonatal Screening (913) 296-1651  
Serology (913) 296-1653  
Virology (913) 296-1645





KANSAS HEALTH & ENVIRONMENTAL LABORATORY  
Department of Health and Environment  
Forbes Field, Bldg. 740, Topeka, Kansas 66620-0001



REPORT OF ANALYSIS

ORGANIC CHEMISTRY

Report To: TOM PETERSON-BER  
Address: FORBES FIELD, BLDG 740,  
TOPEKA, KS 66620

Lab Number: 604218VX  
Date Rec'd: 05/03/96  
Report Date: 05/07/96

Site ID No.:

Acct No:  
Site: MW-3 - MARCO, CHANUTE  
Collected By: KDHE S. STOVER/F. ARNWINE

Sample Type: WATER Program Code: EW  
No. Composit: 0  
Depth: Date: 05/02/96 Time: 14:30

PRIORITY POLLUTANT VOLATILE ORGANIC COMPOUNDS	CONCENTRATION ( ug/L )	Analysis Date	EPA Method
Chloromethane	< 5.0	05/06/1996	624
Bromomethane	< 1.2	05/06/1996	624
Vinyl Chloride	< 0.8	05/06/1996	624
Chloroethane	< 3.7	05/06/1996	624
Dichloromethane	< 0.9	05/06/1996	624
1,1-Dichloroethylene	< 0.6	05/06/1996	624
1,1-Dichloroethane	< 0.5	05/06/1996	624
trans/cis 1,2-Dichloroethylene as trans	< 0.5	05/06/1996	624
Trichloromethane (THM)	< 0.5	05/06/1996	624
1,2-Dichloroethane	< 0.5	05/06/1996	624
1,1,1-Trichloroethane	< 0.6	05/06/1996	624
Tetrachloromethane	< 0.7	05/06/1996	624
Bromodichloromethane (THM)	< 0.5	05/06/1996	624
1,2-Dichloropropane	< 0.5	05/06/1996	624
trans 1,3-Dichloropropene	< 0.8	05/06/1996	624
Trichloroethylene	< 0.6	05/06/1996	624
Benzene	< 0.5	05/06/1996	624
Dibromochloromethane (THM)	< 0.7	05/06/1996	624
cis 1,3-Dichloropropene	< 0.9	05/06/1996	624
1,1,2-Trichloroethane	< 0.6	05/06/1996	624
Bromoform (THM)	< 1.5	05/06/1996	624
1,1,2,2-Tetrachloroethane	< 0.6	05/06/1996	624
Tetrachloroethylene	< 1.1	05/06/1996	624
Toluene	< 0.5	05/06/1996	624
Chlorobenzene	< 0.5	05/06/1996	624
Ethylbenzene	< 0.7	05/06/1996	624
Xylene	< 0.6	05/06/1996	624
1,3-Dichlorobenzene	< 1.0	05/06/1996	624
1,2-Dichlorobenzene	< 1.0	05/06/1996	624
1,4-Dichlorobenzene	< 1.0	05/06/1996	624

Chemist: Richard L. Pierce *RLP*

< - Not Detected at Indicated Level.

*great sample*

RECEIVED

MAY 09 1996

BUREAU OF  
ENVIRONMENTAL  
HEALTH

Environmental Laboratories

Inorganic Chemistry (913) 296-1657  
Organic Chemistry (913) 296-1647  
Radiochemistry (913) 296-1629  
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Health Assessment (913) 296-1636  
Diagnostic Micro. (913) 296-1651  
Neonatal Screening (913) 296-1653  
Serology (913) 296-1653  
Virology (913) 296-1645







# KANSAS HEALTH & ENVIRONMENTAL LABORATORY

Department of Health and Environment  
Forbes Field, Bldg. 740, Topeka, Kansas 66620-0001



## REPORT OF ANALYSIS

### ORGANIC CHEMISTRY

Report To: TOM PETERSON-BER  
Address: FORBES FIELD, BLDG 740,  
TOPEKA, KS 66620

Lab Number: 604219VX  
Date Rec'd: 05/03/96  
Report Date: 05/07/96

Site ID No.:

Acct No:  
Site: MW-4 - MARCO, CHANUTE  
Collected By: KDHE S. STOVER/F. ARNWINE

Sample Type: WATER Program Code: EW  
No. Compositing: 0  
Depth: Date: 05/02/96 Time: 14:10

PRIORITY POLLUTANT VOLATILE ORGANIC COMPOUNDS	CONCENTRATION ( ug/L )	Analysis Date	EPA Method
Chloromethane	< 5.0	05/06/1996	624
Bromomethane	< 1.2	05/06/1996	624
Vinyl Chloride	< 0.8	05/06/1996	624
Chloroethane	< 3.7	05/06/1996	624
Dichloromethane	< 0.9	05/06/1996	624
1,1-Dichloroethylene	< 0.6	05/06/1996	624
1,1-Dichloroethane	< 0.5	05/06/1996	624
trans/cis 1,2-Dichloroethylene as trans	4.2	05/06/1996	624
Trichloromethane (THM)	< 0.5	05/06/1996	624
1,2-Dichloroethane	< 0.5	05/06/1996	624
1,1,1-Trichloroethane	< 0.6	05/06/1996	624
Tetrachloromethane	< 0.7	05/06/1996	624
Bromodichloromethane (THM)	< 0.5	05/06/1996	624
1,2-Dichloropropane	< 0.5	05/06/1996	624
trans 1,3-Dichloropropene	< 0.8	05/06/1996	624
Trichloroethylene	< 0.6	05/06/1996	624
Benzene	< 0.5	05/06/1996	624
Dibromochloromethane (THM)	< 0.7	05/06/1996	624
cis 1,3-Dichloropropene	< 0.9	05/06/1996	624
1,1,2-Trichloroethane	< 0.6	05/06/1996	624
Bromoform (THM)	< 1.5	05/06/1996	624
1,1,2,2-Tetrachloroethane	< 0.6	05/06/1996	624
Tetrachloroethylene	< 1.1	05/06/1996	624
Toluene	< 0.5	05/06/1996	624
Chlorobenzene	< 1.0	05/06/1996	624
Ethylbenzene	< 0.7	05/06/1996	624
Xylene	< 0.6	05/06/1996	624
1,3-Dichlorobenzene	< 1.0	05/06/1996	624
1,2-Dichlorobenzene	< 1.0	05/06/1996	624
1,4-Dichlorobenzene	< 1.0	05/06/1996	624

Chemist: Richard L. Pierce

< - Not Detected at Indicated Level.

final sample

RECEIVED

MAY 09 1996

#### Environmental Laboratories

Inorganic Chemistry (913) 296-1657  
Organic Chemistry (913) 296-1647  
Radiochemistry (913) 296-1629  
Env. Microbiology (913) 296-0971

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HEALTH LABORATORIES  
Diagnostic Micro. (913) 296-1636  
Neonatal Screening (913) 296-1651  
Serology (913) 296-1653  
Virology (913) 296-1645



**APPENDIX C**  
**PHASE I FIELD REPORTS**



GOLDER ASSOCIATES  
200 Union Blvd., Suite 100  
Lakewood, Colorado 80228-1830

(303) 980-0540

KDHE

THE FOLLOWING WAS NOTED

DATE	12/8/97	JOB NO	973-2300.4
PROJECT	KDHE/MARCO C.I/KS		
LOCATION	MID-AMERICA REFINERY Co.; CLANUTE, KANS		
CONTRACTOR	HydroLOGIC INC.	OWNER	
WEATHER	CLDY/RAIN	TEMP	° at 3:00 PM 35° at 3:00 PM
PRESNT AT SITE			
M KELLER			
R. MARCH			

1500 ARRIVE IN CLANUTE. MEET BILL TUDINGTON @ KDHE South DISTRICT OFFICE TO PICK-UP MARCO KEYS.

1530 MET WITH EMITT & GERCKE REPS TO DISCUSS PLACEMENT OF DRILL LOCATION FLAGS.

1600 UTILITY LOCATORS ON SITE:

EGE - PARSONS - RINDY LUCKE

TELEPHONE OPTIC - RINDY JOHNSON

CITY OWNED GAS - DAVE ?

REMAINDER OF UTILITIES WILL BE CLARED TOMORROW

1700 MET WITH ASH GOWNE AND PARKY'S REPS, FINISH LOCATING PROBABLE WIRE FOR F-10 F-10.

1800 LEAVE SITE

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FIELD REPORT

SIGNED

M. KELLER



GOLDER ASSOCIATES  
200 Union Blvd., Suite 100  
Lakewood, Colorado 80228-1830

(303) 980-0540

1- KLE  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

DATE	12/9/97	JOB NO	973-2300.4
PROJECT	KDHE/MARCO C.I./KS		
LOCATION	MID-AMERICA REFINERY Co.; CLANUTE, KANS.		
CONTRACTOR	HydroLOGIC Inc.	OWNER	
WEATHER		TEMP	38° at 7:30 AM 33° at 1730 PM
PRESSENT AT SITE	R. March S. Hoff M. Keller J. James D. Dineen		

THE FOLLOWING WAS NOTED

0730 MET - KLE @ MARCO ENTRANCE.  
0800 MET with Rob from Ash Grove for site safety  
& perform GOLDER LISP REVIEW.  
0900 MET with remaining LISPERS & REVIEW TEST SITE LOCATIONS, ENTIRE  
SITE & DISCUSS DRILLING DIRECTIONS  
1015 SET UP @ P-10; CALIBRATE PHOSPHOR P10 AND HYDRA PH/COND METER  
1115 GRAIN CORE FOR LOG SAMPLE P10-S-1 (7.5' DEEP) @ 7.5' DEEP & 2'  
1215 TO 1245 @ 12.5' REFUSAL @ PENETROMETER  
1300 INSTALL 1" PVC MINI-WELL  
1345 LOG P-10 & P-18 (P-18 1" E PLUG COMPLETED)  
1400 LUNCH  
1445 @ P-18 SET-UP  
1450 BEGIN CORE, 1" - SAMPLE P18-S-1 @ 3.0' DEEP & 2'  
1515 @ 5' DEEP WITH 2" CORE TO 12  
1545 INSTALL 1" MINI-WELL  
1615 BEGIN DEVELOPMENT OF P-18 @ 12.5' DEEP (5 GALS) REMOVED,  
FULL SCREENING AND TUBATE SAMPLES @ 640  
1700 DECON AND RETURN TO MARCO LK @ 12.5' DEEP & 2" CORE  
1730 LEAVE SITE

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FIELD REPORT

SIGNED M. KELLER





**GOLDER ASSOCIATES**  
200 Union Blvd., Suite 100  
Lakewood, Colorado 80228-1830

(303) 980-0540

DATE 12/10/97		JOB NO 973-2300.4	
PROJECT KDHE/MARCO C.I./KS			
LOCATION MID-AMERICA REFINERY Co.; CLANUTE, KANS.			
CONTRACTOR HydroLOGic Inc.		OWNER	
WEATHER CLOUDY / 50'S		TEMP 32 ° at 730 AM 28 ° at 1030 PM	
PRESENT AT SITE			
P. MARCH		D. DILLANEY	
M. KELLY		S. KEMP	
		J. JAMES	

THE FOLLOWING WAS NOTED

0730 A. Forthright location P-9 NE corner of the East property  
0800 P. Forthright P-9. P. Forthright to 15' well depth in 10'  
P. Forthright 'P-9' on site to 15' depth in 10'  
SAMPLE P-9-S-1 - TAKEN ABOVE P. Forthright 'P-9' 1' WATER P-9  
0930 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1000 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1030 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1100 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1130 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1200 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1230 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1300 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1330 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1400 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1430 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1500 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1530 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1600 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1630 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1700 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1730 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1800 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1830 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1900 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
1930 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
2000 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
2030 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
2100 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
2130 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
2200 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
2230 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.  
2300 P. Forthright P-9 to SET WELL. Collectors present P-9 & HYDRA PHENS.

# FIELD REPORT

COPIES TO \_\_\_\_\_

SIGNED \_\_\_\_\_



GOLDER ASSOCIATES  
200 Union Blvd., Suite 100  
Lakewood, Colorado 80228-1830

(303) 980-0540

1.

KDHE

816-591-4136

THE FOLLOWING WAS NOTED

DATE	12/11/97	JOB NO	973-2300.4
PROJECT	KDHE/MARCO C.I/KS		
LOCATION	Mid-America Refinery Co.; Chanute, KANS.		
CONTRACTOR	HydroLOGIC Inc.		OWNER
WEATHER	SNOW/CLOUD		TEMP 31 °at 0730 AM °at PM
PRESNT AT SITE	M. KELLER		D. DIANEY J. Jacobs

0730 MET HLI @ MARCO GATE, LARGE Mobil Lab will NOT be able to  
Lab TO SITE, Samples for Drisel Range TPH sample will be SENT TO  
THE LAB.

0815 @ P-11 CONTINUE, Calibrate MINIMA M-1000 FID & HPMC, probe to  
REFUSAL @ 17' ALL SCREENING WATER SAMPLE, Abandon Hole

11245 Move to P-10 MIN-WELL WAS INSTALLED 12/10 Develop & full  
Screening Sample P10-W-1.

1000 @ North's P-12, SET UP, REFUSAL @ 21'

1130 SET WELL, & complete

1245 Develop WELL By purging 5 casing VOL (2.4 GAL) full sample P12-W-1 @ 1310

1345 Lunch

1445 @ Bruce's P-19, SET UP, probe to REFUSAL @ 21'

1540 SET WELL & complete

1640 Develop well By purging 7 casing VOL (5.4 GAL) full sample P19-W-1 @ 1656

1710 SET UP @ P-17, SET UP probe to REFUSAL @ 25' sample P17-S-1 @ 3'

1800 Sample P17-W-1 pulled.

1830 LEAVE SITE

COPIES TO \_\_\_\_\_

FIELD REPORT

SIGNED M. KELLER



GOLDER ASSOCIATES  
200 Union Blvd., Suite 100  
Lakewood, Colorado 80228-1830

(303) 980-0540

KDHE

DATE	12/12/97	JOB NO	973-2300.4
PROJECT	KDHE/MARCO C.I./KS		
LOCATION	MID-AMERICA REFINERY Co.; CLANUTE, KANS		
CONTRACTOR	HydroLOGIC Inc.	OWNER	
WEATHER	cloudy / snowing	TEMP	29 ° at 0730 AM ° at PM
PRESENT AT SITE	M. KEISER	D. DUNN	P. LANE
		S. KNAPP	MIKE

THE FOLLOWING WAS NOTED

0730 @ Marco Site, HLT loading supplies, DECOR fig  
0820 @ P-14, set up, calibrate Hydac / photovac drill to refusal @ 25' sample P14-S-1 & DUPE @ 255  
1000 SET & COMPLETE WELL  
1030 Purge 5 casing vol (24 gals) & collect screening (P14-W-1) & DUPE (P14-W-1D) samples  
1100 @ P-16, set up, drill to refusal @ 22' sample P-16-S-1 & DUPE @ 22'  
1230 SET & COMPLETE WELL  
1320 Purge 5 casing vol (24 gals) & collect screening sample (P16-W-1)  
DECOR  
1400 Lunch  
1500 @ P-2, set-up drill to refusal @ 21' sample P2-S-1 @ 21'  
1630 SET & COMPLETE WELL  
1700 @ P-1 set-up drill to refusal @ 22'  
1745 P. L. screening sample P1-W-1, DECOR fig  
1800 @ P-2 sample P2-W-1 and duplicate P2-W-2 pulled @ 22'  
1830 SET & COMPLETE WELL

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FIELD REPORT

SIGNED M. KEISER



GOLDER ASSOCIATES  
200 Union Blvd., Suite 100  
Lakewood, Colorado 80228-1830

(303) 980-0540

70 KINE

THE FOLLOWING WAS NOTED

DATE	12/13/97	JOB NO	973-2300.4
PROJECT	KDHE/MARCO C.I/KS		
LOCATION	MID-AMERICA REFINERY Co.; CLANUTE, KANS.		
CONTRACTOR	HydroLOGIC Inc.	OWNER	
WEATHER	SUNNY/COLD	TEMP	22 ° at 07:00 AM 38 ° at 6:00 PM
PRESSENT AT SITE	M. KELLER	D. TUNNEY	
		P. FROU	
		S. KNAPP	
		M. K.	

0730 1st DECON

0800 @ Borehole P-6, probe to refusal @ 35, advise to 15 E  
calibrate Hydrac & photovac PID

0900 Set & complete well, run of 2 full samples 16-1-1

0950 @ Borehole P-4, probe to refusal @ 20 E

1050 Set & complete well, run of 2 full samples 16-1-1 @ 1100

1100 1st DECON

1130 @ Borehole P-5, probe to refusal @ 11 E full samples P5-S-1, P5-W-1  
Abandon Hole DECON

1300 @ Borehole P-3, probe to refusal @ 21 E full samples P3-S-1, P3-W-1  
Abandon Hole @ 1405

1400 - 1450 Lunch

1500 @ Borehole P-15, probe to refusal @ 23 E full samples P15-S-1, P15-W-1  
AND P15-W-1D @ 1600  
Meet with Gary Wallace (Sueverol) & locate Boreholes for him.

1600 S. WAPP will purge & sample M1, M2, & M4 ON MARCO SITE

1630 @ Borehole P-20, probe to refusal @ 1 E full samples P20-S-1, P20-W-1  
& P20-W-1D @ 1720  
The low area from the Marco site through P20 seems to be the  
preferred pathway for contaminant migration. P20 was in the most  
contaminated location observed. Free product was observed on drilling equipment &  
in groundwater. DECON Rig & Equip

1800 @ Borehole P-13, probe to refusal @ 14 E full samples P13-S-1 & P13-W-1

1930 Sample M1, following purge  
OPIES TO  
2030 LEAVE SITE

FIELD REPORT

SIGNED

M. KELLER





GOLDER ASSOCIATES  
200 Union Blvd., Suite 100  
Lakewood, Colorado 80228-1830

(303) 980-0540

KDHE

DATE	12/14/97	JOB NO	973-2300.4
PROJECT	KDHE/MARCO C.I/KS		
LOCATION	MID-AMERICA REFINERY Co.; CLANUTE, KANS.		
CONTRACTOR	HydroLOGIC Inc.	OWNER	
WEATHER	Clear / Cool	TEMP	30° at 800 AM 45° at 1230 PM
PRESENT AT SITE	M. KELLER		

THE FOLLOWING WAS NOTED

900 - @ MARCO SITE, MAKING FINAL ROUNDS TO  
ALL WELL LOCATIONS TO VERIFY WELL COMPLETIONS &  
RECORD LATEST WATER LEVELS.

1000 - LOCK @ P-7 WILL NOT COME OFF, CUT LOCK &  
REPLACED WITH LOCK FROM WELL P-2.

1100 - PROTECTIVE POSTS FOR WELLS P-7 & P-9 HAVE NOT  
BEEN SET, WILL ASK HLI TO COMPLETE THOSE  
& PUT NEW LOCK ON P-2.

LEAVE SITE

COPIES TO \_\_\_\_\_

FIELD REPORT

SIGNED M. KELLER



**APPENDIX D**

**REPRESENTATIVE PHASE I PHOTOGRAPHS**





PHOTO D-1A: DIRECT PUSH PROBING AT P-7



PHOTO D-1B: EXTRUDED SOIL CORE AT P-12



CLIENT/PROJECT

**KDHE  
MARCO INVESTIGATION**

TITLE

**REPRESENTATIVE PHASE I PHOTOGRAPHS**

DRAWN

DB

DATE

JANUARY 1998

JOB NO

973-2300

CHECKED

MJK

SCALE

DWG NO /REV NO

A029

REVIEWED

RSM

FILE NO

2300A029

FIGURE NO

D-1





PHOTO D-2A: MINI-WELL INSTALLATION AT P-9



PHOTO D-2B: GROUNDWATER SAMPLING OF MINI-WELL P-9



**KDHE  
MARCO INVESTIGATION**

CLIENT/PROJECT

DATE

## REPRESENTATIVE PHASE I PHOTOGRAPHS

DRAWN  
CHECKED  
REVIEWED

DB

DATE

JANUARY 1998

JOB NO

973-2300

SCALE

N/A

DWG NO /REV NO

A030

FILE NO

2300A030

FIGURE NO

D-2







PHOTO D-3A: ABOVE-GRADE MINI-WELL COMPLETION AT P-18

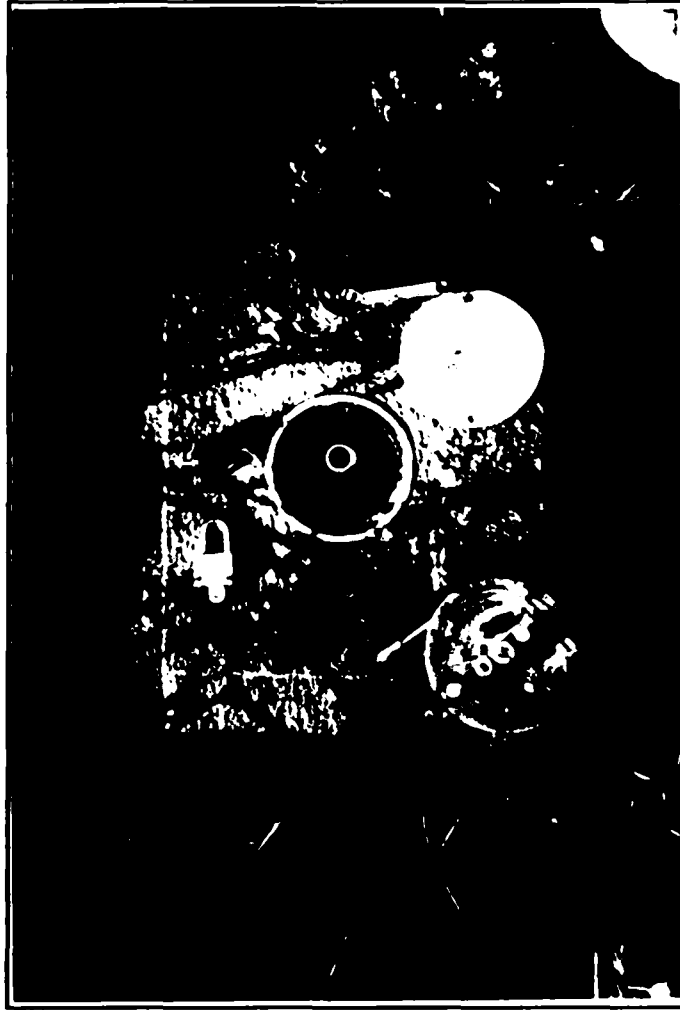


PHOTO D-3B: FLUSH-MOUNT MINI-WELL COMPLETION AT P-10



**KDHE  
MARCO INVESTIGATION**

# REPRESENTATIVE PHASE I PHOTOGRAPHS

CLIENT/PROJECT	DRAWN	DB	DATE	JANUARY 1998	JOB NO	973-2300
	CHECKED	MJK	SCALE	N/A	DWG NO / REV NO	A031
	REVIEWED	RSM	FILE NO	2300A031	FIGURE NO	D-3



**APPENDIX E**  
**SOIL BOREHOLE LOGS**

1

2

3

4

# SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LESS THAN 5% FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (MORE THAN 12% FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LESS THAN 5% FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SANDS WITH FINES (MORE THAN 12% FINES)			SM	SILTY SANDS, SAND-SILT MIXTURES	
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT <u>MORE</u> THAN 50%		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT <u>LESS</u> THAN 50%		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OR HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.



Denver, Colorado

TITLE

## UNIFIED SOIL CLASSIFICATION SYSTEM

CLIENT/PROJECT

**KDHE  
MARCO INVESTIGATION**

DRAWN

RB

DATE

JAN. 1998

JOB NO

973-2300.7

CHECKED

MJK

SCALE

N.T.S.

DWG NO / REV. NO.

A032

REVIEWED

RSM

FILE NO

2300A032

FIGURE NO.

**E-1**



# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>		BORING NO. <b>P-1</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1 OF 2</b>	
N: 2623 E: 104		Sampling using <b>48" CORE TUBES</b> <b>AND LINERS</b>		DRILLING	
DATUM		ELEVATION (NGVD) <b>913.6</b>		START	FINISH
		WATER LEVEL <b>1-</b>		TIME	TIME
		TIME <b>1741</b>		<b>1710</b>	<b>1735</b>
		DATE <b>12/12</b>		DATE	DATE
		CASING DEPTH		<b>12/12/97</b>	<b>12/12</b>
DRILL RIG <b>SINCO Earthprobe 2000</b>		SURFACE CONDITIONS <b>North of Tascara property</b>			
ANGLE <b>90°</b> BEARING		<b>on grassy area</b>			
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT.-LBS					

DEPTH IN FEET (ELEVATION)	RUN# (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

1	①			(0-1 <sup>5</sup> ) Mixture of clay, gravel and asphalt (Fill)						
2	2 <sup>8</sup> / <sub>4</sub>		NR	(1 <sup>5</sup> -5 <sup>5</sup> ) stiff, brownish black (5yr 2/1), silty clay, tr. fn gravel, damp to wet (CL)						
4										
5	②									
6	3 <sup>2</sup> / <sub>4</sub>		NR							
7										
8				(5 <sup>5</sup> -21 <sup>2</sup> ) soft to firm, moderate yellowish brown (10yr 7/4) silty clay, little med. sand, freq. staining, wet (CL)						
9	③									
10	2 <sup>2</sup> / <sub>4</sub>		NR							
11										
12				(21 <sup>2</sup> -22 <sup>5</sup> ) loose, fine brown (5yr 5/2), sandy silt, little med. sand, some staining (GM)						
14	④		NR							
15	4 <sup>5</sup> / <sub>4</sub>									

water @ 4'

phosphate pid readings  
Background : 0 ppm  
sample core : 0 ppm

DRILLING CONTR **HydroLogic Inc.**

LOGGED BY **M. KELLER**

DATE **12/12/97** CHK'D BY **RSM**

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# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>  <b>MID-AMERICA REFINERY CO. SITE</b>		DRILLING METHOD: <b>DIRECT PUSH</b>		BORING NO. <b>P-1</b>	
		<b>(GEOPROBE Rg)</b>		SHEET <b>2 OF 2</b>	
		SAMPLING METHOD: <b>CONTINUOUS</b>		DRILLING	
		<b>Sampling using 48" CORE TUBES</b>		START	FINISH
		<b>AND LINERS</b>		TIME	TIME
		WATER LEVEL		DATE	DATE
TIME					
DATE					
CASING DEPTH					
DATUM		ELEVATION			
DRILL RIG		SURFACE CONDITIONS			
ANGLE <b>90°</b>		BEARING			
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS			

DEPTH IN FEET (ELEVATION)	(RECOVERY)	SOIL GRAPH	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
							FROM	TO	
16									
17									
18									
19									
20									
21									
22									
23									
9									
10									
11									
12									
13									
14									
15									

\* NO RECOVERY ON RUN 5  
 A PACK WAS BLOCKING  
 THE CUTTING SLIDE. CORE  
 TUBE WAS REPUSHED TO  
 REFUSAL @ 22'.

REFUSAL @ 22'

DRILLING CONTR HydroLogic Inc.

LOGGED BY M. KELLER

DATE        CHK'D BY BSM



# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>		BORING NO. <b>P-2</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1 OF 2</b>	
		<b>Sampling using 48" CORE TUBES</b>		DRILLING	
		<b>AND LINERS</b>		START	FINISH
		WATER LEVEL		TIME	TIME
DATE				DATE	DATE
ELEVATION <b>914.7</b> (NGVD)		CASING DEPTH		<b>12/12/97</b>	<b>12/12</b>
DRILL RIG <b>SIMCO Earthdriller 200</b>		SURFACE CONDITIONS <b>Grass Area on top of building</b>			
ANGLE <b>90°</b> BEARING		<b>PROPERTY SURVEY OF BUILDINGS</b>			
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT.-LBS					

DEPTH IN FEET (ELEVATION)	R/W # (RECOVERY)	SOIL GRAPH	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
							FROM	TO	

1			(0-15) soft, dusky yellowish brown (10 or 7 1/2), silty, fine sand, some coarse sand (bottom 5 ft. approx.) (CL)						Sample P2-S-1 taken @ 3' wet zone @ 4' - strong odor -
2									
3									
4			(15-55) soft brown firm, black (NI), silty clay, little fine sand, petroleum stained (odor) damp (CL)						Photovac P23 (P23-155) Background: 0.5 ppm Sample core @ 5' 15.0 ppm 15.5 10.4 ppm 20.2 10.1 ppm
5									
6									
7									
8									
9									
10			(55-150) firm, dark yellowish brown (10 or 4 1/2), silty clay, FeO staining moist to damp (CL)						
11									
12									
13			(152-65) SAA soil stained (odor)						
14									
15									

DRILLING CONTR **Hydro Logic Inc.**

LOGGED BY **M. KELLER**

DATE **12/12/97** CHK'D BY **RSM**



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# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION

KDHE / MARCO CI/KS  
973-2300.4

DRILLING METHOD:

DIRECT PUSH

(GEOPROBE Rg)

BORING NO.

P-2

SHEET

2 OF 2

SAMPLING METHOD:

CONTINUOUS

SAMPLING USING 48" CORE TUBES  
AND LINESS

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

DATE

DATE

DATE

CASING DEPTH

DATUM

ELEVATION

DRILL RIG

SURFACE CONDITIONS

ANGLE

90°

BEARING

SAMPLE HAMMER TORQUE

~150 PSI

FT.-LBS

DEPTH IN FEET (ELEVATION)	PUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASINO TYPE	BLOWS/FOOT ON CASINO	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
16	(5)			(16 <sup>2</sup> -20 <sup>3</sup> ) FRM, DECK YELLOWISH BROWN (10 yr 4/2) SILT CLAY, FEV STAINING, MOIST TO DAMP (CL)						
19				(19 <sup>2</sup> -20 <sup>3</sup> ) BECOMING VERY SOFT INCREASE SAND CONTENT						
20	(6)			(20 <sup>3</sup> -20 <sup>6</sup> ) SFT, OLIVE GRAY (SY 4/1) SANDY CLAY, SOME SILT, DAMP (SC)						
21										
22				(20 <sup>6</sup> -21 <sup>4</sup> ) LOOSE, LIGHT OLIVE GRAY (SY 4/1), SWEET GRAVELLY SAND, SOME CLAY, LITTLE SILT, DAMP (SC-EC)						
24				(21 <sup>4</sup> -21 <sup>7</sup> ) LIGHT WEATHERED, TAN YELLOWISH ORANGE (10 yr 4/2) MEDIUM GRAINED, VERY WEAK SANDSTONE						
25										

petroleum stained zone  
between lithologies @  
20<sup>3</sup>

REFUSAL @ 21<sup>7</sup>

DRILLING CONTR HydroLogic Inc.

LOGGED BY M. KELLER

DATE CHK'D BY RSM



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# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS 973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH (Geoprobe Rg)</b>		BORING NO. <b>P-3</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1 OF 2</b>	
		Sampling using <b>48" CORE TUBES</b>		DRILLING	
		AND LINERS		START	FINISH
		WATER LEVEL	<b>1<sup>st</sup></b>		
DATE <b>12/13</b>		DATE <b>12/13/97</b>		DATE <b>12/13</b>	
DATUM E: <b>103</b>		ELEVATION (NGVD) <b>913.3</b>		CASING DEPTH	
DRILL RIG <b>SIMCO Earthprobe 200</b>		SURFACE CONDITIONS <b>YARD @ NW CORNER OF GERICKE WAREHOUSE</b>			
ANGLE <b>90°</b>		BEARING			
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS			

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACT.	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET FROM TO	DESCRIPTION OF OPERATION AND REMARKS
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1	①			(0-3 <sup>ft</sup> ) MISCELLANEOUS FILL MATERIAL					<div>STRONG HCL REACTION 0-3<sup>ft</sup> with GRAVEL IN FILL MATERIAL</div>
2	4 <sup>ft</sup> 4 <sup>ft</sup>			(3 <sup>ft</sup> -7 <sup>ft</sup> ?) FIRM, DARK GRAY (NG), SILTY CLAY, TRACE F-MED SAND, DAMP TO WET					
3				(CL)					
4									
5	②			(7 <sup>ft</sup> ?-18 <sup>ft</sup> ) FIRM TO STIFF, MOTTLED DARK YELLOWISH ORANGE (10YR 6/6) TO PALE YELLOWISH ORANGE (10YR 6/2), SILTY CLAY, LITTLE F-M MED. SAND, TR. FN GRAVEL, FeOx STAINING, DAMP					<div>PHOTOVAC PID READINGS BACKGROUND: 1.5 pM SAMPLE CORE: 1.5 pM</div>
6	0 <sup>ft</sup> 4 <sup>ft</sup>								
7									
8									
9	③			(18 <sup>ft</sup> -19 <sup>ft</sup> ) LOOSE, PALE BROWN (5YR 5/2), SANDY CLEAN GRAVEL, LITTLE CLAY, WET					
10	3 <sup>ft</sup> 3 <sup>ft</sup>								
11									
12	④			(GC)					
13	4 <sup>ft</sup> 4 <sup>ft</sup>								
14									
15									



DRILLING CONTR **HYDROLOGIC INC.**

LOGGED BY **M. KELLER**

DATE **12/13/97** CHK'D BY **RSM**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>		BORING NO. <b>P-3</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>2 OF 2</b>	
		<b>Sampling using 48" CORE TUBES AND LINERS</b>		DRILLING	
		WATER LEVEL		START	FINISH
		TIME		TIME	TIME
DATE		DATE		DATE	
CASING DEPTH		DATE		DATE	
DATUM		ELEVATION			
DRILL RIG		SURFACE CONDITIONS			
ANGLE <b>90°</b>		BEARING			
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS			

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

15	⑤		NR	(19'-20') Loose, dark yellowish brown (10yr 4/2), poorly graded, med SAND, little silt, little clay, damp to wet (SC-SH)						
16	18									
17	4°									
18				(20'-21') grading into a sandy GRAVEL, SEE 18'-19' (GC)						
19	⑥		NR	(21'-21½) highly weath., massive, dark yellowish orange (10yr 6/6), med grained, very weak, SANDSTONE						
20	2°									
21	2½									
22										Probe refusal @ 21½
23										
24										
25										

DRILLING CONTR **HYDROLOGIC INC.**

LOGGED BY **M. KELLER**

DATE **\_\_\_\_\_** CHK'D BY **RSM**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION  
KDHE / MARCO CI / KS  
973-2300.4

MID-AMERICA REFINERY CO. SITE

N: 1848  
DATUM E: 47  
ELEVATION 914.9 (MSVD)

DRILLING METHOD: DIRECT PUSH  
(GEOPROBE R<sub>g</sub>)

BORING NO.  
P-4

SAMPLING METHOD: CONTINUOUS  
SAMPLING USING 48" CORE TUBES  
AND LINERS

SHEET  
1 OF 2

WATER LEVEL 4.0  
TIME 1015  
DATE 12/13  
CASING DEPTH

DRILLING  
START  
TIME 1000  
DATE 12/13/01  
FINISH  
TIME 1100  
DATE 12/13

DRILL RIG SMC F-1000 200

SURFACE CONDITIONS GRASS AREA @ NW CORNER  
OF GERICKE MAIN BUILDING

ANGLE 90° BEARING  
SAMPLE HAMMER TORQUE ~150 PSI FT.-LBS

DEPTH IN FEET (ELEVATION)	# (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1	1			(0-29) FIRM, DUSKY BROWN (S <sub>yc</sub> 34) silty clay to clayey S <sub>it</sub> , some med sand, trace fn gravel, lamp (topsoil/fill) (CL-MI)						sample pit-S-1 taken @ 3 <sup>5</sup>
2	2			[STAIN LAYER @ 18]						water @ 4.0
3	3			(29-43) SOFT, DUSKY BROWN'S (R <sub>3</sub> ) becoming grayish black (M <sub>2</sub> ), silty sand, some clay, some fn gravel, wet, oxidation in color due to iron-iron staining (SM)						<div>                     PHOTONUC PID READINGS:                      Background 11.3 ppm                      sample core @ 3<sup>5</sup>: 50 ppm                      4<sup>5</sup>: 90 ppm                      15<sup>5</sup>: 4 ppm                      19<sup>5</sup>: 400 ppm                 </div>
4	4			(43-98) FIRM, GRAYISH BLACK (M <sub>2</sub> ), silty clay, to silty med sand, lamp, wet iron-iron staining (CL)						
5	5			(98-105) FIRM, GRAYISH BROWN (M <sub>2</sub> ), silty clay, to silty med sand, lamp, wet iron-iron staining (CL)						
6	6									
7	7									
8	8									— STRONG ODOR —
9	9									
10	10									
11	11									
12	12									
13	13									
14	14									
15	15									

DRILLING CONTR HYDROLOGIC INC.

LOGGED BY M. KELLER

DATE CHK'D BY RSM



# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b>				BORING NO. <b>P-4</b>	
		<b>(GEOPROBE Rg)</b>				SHEET <b>2 OF 2</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>				DRILLING	
		<b>Sampling using 48" CORE TUBES</b>				START	FINISH
		<b>AND LINERS</b>				TIME	TIME
		WATER LEVEL				DATE	DATE
DATUM		ELEVATION		CASING DEPTH			
DRILL RIG		SURFACE CONDITIONS					
ANGLE <b>90°</b>		BEARING					
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS					

DEPTH IN FEET (ELEVATION)	Run # (RECOVERY)	SOIL GRAPH	REL. RECOVERY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET FROM TO	DESCRIPTION OF OPERATION AND REMARKS
16	5			(12.5 - 14.5) SOFT, MED. DARK GRAY (N4), WITH CLAY, SOME F.M. SAND, WET, FERRUGIN STAINING (CL)					
18	4		NR	(14.5 - 17.5) FIRM, DARK YELLOWISH BROWN (10YR 4/5), SILTY CLAY, TO FA SAND, SOME FEOX STAINING, DAMP (CL)					
20	6		NR	(17.5 - 18.5) SOFT, PLE. YELLOW BROWN (10YR 4/2), SANDY CLAY, SOME SILT, DAMP (SC)					
22				(18.5 - 19.5) LOOSE, PALE BROWN (5YR 5/2) SILTY POORLY SORTED SAND, LITTLE CLAY, TO FA GRAVEL, DUMP TO WET, FERRUGIN STAINING (SU)					
24				(19.5 - 22.5) LOOSE MED GRAY (N4), SANDY SILTY GRAVEL, LITTLE CLAY, DUMP TO WET (SC)					probe refusal @ 22.5

DRILLING CONTR **HYDRO LOGIC INC.**

LOGGED BY **M. KELLER**

DATE **PSM** CHK'D BY





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>		BORING NO. <b>P-5</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1</b> OF <b>1</b>	
		<b>Sampling using 48" CORE TUBES</b>		DRILLING	
		<b>AND LINERS</b>		START TIME	
		WATER LEVEL <b>2 1/2'</b>		FINISH TIME	
TIME <b>12:50</b>		DATE <b>12/13</b>		DATE <b>12/13/97</b>	
DATE <b>12/13</b>		CASING DEPTH		DATE <b>12/13</b>	
N: <b>1619</b> DATUM E: <b>-305</b>		ELEVATION <b>(NGVD)</b> <b>924.8</b>			
DRILL RIG <b>SINCO CATHYPROBE 200</b>		SURFACE CONDITIONS <b>Grass Area North of Stone</b>			
ANGLE <b>90°</b>		BEARING <b>Face TV</b>			
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS			

DEPTH IN FEET (ELEVATION)	MIN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1	①			(0-13) SOFT, DUSKY BROWN (SYR 7.5) SLY CLAY TO SILTY SAND, SOME FINE (CL)						
2	20/40			(13-14) HARD, WEATHERED, DARK YELLOWISH ORANGE (10R 6.5), MED GRAINED, VERY WEAK, SANDSTONE, (SINGLE OR ISLAND ROCK)						
3				(14-15.2) SOFT, MEDIUM BROWN (SYR 7.5) SLY CLAY - MED SAND, CAMP, FINE SILTY (CL)						
4				(15.2-20) SANDSTONE - FINE, SEE (13-14)						
5				(20-21.8) FCM, FINE YELLOWISH BROWN (10R 6.5) TO MED YELLOWISH ORANGE (10R 6.5), SANDY CLAY, SOME SILT, CAMP						
6				(21.8-22.5) (SC) BROWNISH GRAY SAND						
7				(22.5-23.5) MEDIUM WEATHERED, MED GR, (10R 6.5) SLY CLAY						
8										
9										
10										
11										
12										
13										
14										
15										

GEOPROBE PID READINGS  
Background: 1.8 ppm  
CORE SAMPLES: 1.8 ppm

SAMPLE 15-21 @ 22.5

PROBE RECAL @ 11.2  
WATER @ BOREHOLE  
CONTACT.

DRILLING CONTR **HYDROLOGIC INC.**

LOGGED BY **M. KELLER**

DATE **12/13/97** CHK'D BY **RSM**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>		BORING NO. <b>P-6</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1</b> OF <b>1</b>	
		<b>Sampling using 48" CORE TUBES</b>		DRILLING	
		<b>AND LINERS</b>		START TIME <b>8:15</b>	
		FINISH TIME <b>9:00</b>			
DATE <b>10/1/97</b>		DATE <b>12/13</b>			
WATER LEVEL		TIME			
TIME		DATE			
CASING DEPTH					
DATUM <b>N: 1630</b> <b>E: -480</b>		ELEVATION (NGVD) <b>934.3</b>			
DRILL RIG <b>SMCO Earthprobe 200</b>		SURFACE CONDITIONS <b>Grassy, recent lot</b>			
ANGLE <b>90°</b>		BEARING <b>S/W of main site</b>			
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS			

DEPTH IN FEET (ELEVATION)	WIN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET (FROM TO)	DESCRIPTION OF OPERATION AND REMARKS
1	1			(0-2') Loose, silty brown (SYR 2/6), silty sand, little gravel, roots/s/organics, moist (TOPSOIL)					
2	2								
3	3								probe refusal @ 3'
4				(2'-3') Loose to firm, dark yellowish orange (10YR 6/6), silty sand some inter-clay layers, moist					Rotary Auger (4") to completion depth
5									
6									
7									
8				(3'-3.5') Highly weathered, massive, dark yellowish orange (10YR 6/6), fine grained, weak, sandstone					
9									
10									
11									
12									
13									
14									
15									

DRILLING CONTR **HydroLogic Inc.**

LOGGED BY **M. KELLER**

DATE **12/13/97** CHK'D BY **RSW**



# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION KDHE / MARCO CI / KS 973-2300.4		DRILLING METHOD: DIRECT PUSH (GEOPROBE Rg)		BORING NO. P-7	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: CONTINUOUS		SHEET 1 OF 1	
		Sampling using 48" CORE TUBES		DRILLING	
		AND LINERS		START	FINISH
		WATER LEVEL	9 1/2' (MC)	TIME	1100
DATE		12/10	DATE	12/10	DATE
CASING DEPTH					
N: 2086 DATUM E: -1326		ELEVATION 9563 (NOVD)		SURFACE CONDITIONS GLASSY AREA SOUTHWEST	
DRILL RG < MCD EARTHBORE 200		ANGLE 90°		BEARING OF ECTT BUILDING	
SAMPLE HAMMER TORQUE 2150 PSI		FT.-LBS			

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL LOCATION	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1	35			(0-2') LOOSE, TAILY YELLOWISH BROWN (10YR 5/2) CLAYEY SILT, SOME FIN-RED SAND. MOIST TO TAMP, MNCV/FeOx STAINING (TOPSOIL) (ML)						- DIST. TONE OF 1/8
2	35			(2'-35') HIGHLY WEATHERED, FINELY LAMINATED, DARK YELLOWISH ORANGE (10YR 5/2), FINE WHITE, VERT. FRAK, SANDSTONE, INCL. CLAYEY ORGANICS & CLAYS 2'-3'. FeOx STAINING						Probe PENETRAL AT 35
4										RETRACT ALLEG (4") TO COMPLETION DEPTH
5										
6										
7										
8										
9										
10										
11										
12										
14										
15										

DRILLING CONTR HydroLogic Inc.

LOGGED BY M. KELLER

DATE CHK'D BY RSM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(Geoprobe Rg)</b>		BORING NO. <b>P-8</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1</b> OF <b>1</b>	
		<b>Sampling using 48" CORE TUBES</b>		DRILLING	
		<b>AND LINERS</b>		START	
		WATER LEVEL <b>42</b> <b>32</b>		TIME <b>0945</b> <b>1015</b>	
TIME <b>955</b> <b>1035</b>		DATE <b>12/10</b> <b>12/10</b>		DATE <b>12/10/17</b> <b>12/10</b>	
DATE <b>12/10</b>		ELEVATION <b>(NGVD)</b> <b>947.3</b>		CASING DEPTH	
DRILL RIG <b>SIMCO Geoprobe 200</b>		SURFACE CONDITIONS <b>FAST OF FOOT BUILDING</b>			
ANGLE <b>90°</b> BEARING		<b>Along MARCO FENCE LINE</b>			
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT.-LBS					

DEPTH IN FEET (ELEVATION)	Run # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET FROM TO	DESCRIPTION OF OPERATION AND REMARKS
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1	32			(0-23) LOOSE, DUSKY yellowish BROWN (10yr 7/2), clayey SILT (topsoil), SOME FN-MED SAND, MOIST TO DAMP (ML)					Soil Sample (P8-S-1) - TAKEN @ 22
2	32								
3									Probe REFUSAL @ 35
4				(23-35) Highly weath, thinly laminated, dark yellowish orange (10yr 5/6), FINE GRAINED, VERY WEAK, SANDSTONE, SOME FeOx staining					Rotary Auger (4") TO COMPLETION DEPTH
5									
6									
7									
8									
9									
10									
11				Completion Depth @ 103					PID READINGS:
12									Background: 0 ppm
13									Sample Core: 0 ppm
14									Water Sample P8-W-1 pulled @ 1031
15									pH - 7.00 COND - 1320 TEMP 46.3

DRILLING CONTR **HydroLogic Inc.**

LOGGED BY **M. KELLER**

DATE **12/10/17** CHK'D BY **PSM**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>  <b>MID-AMERICA REFINERY CO. SITE</b>  N: 2577 DATUM E: -1077 ELEVATION (NGVD): 942.4	DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>				BORING NO.: <b>P-9</b>	
	SAMPLING METHOD: <b>CONTINUOUS</b>				SHEET <b>1</b> OF <b>1</b>	
	Sampling using <b>48" CORE TUBES</b> <b>AND LINERS</b>				DRILLING	
	WATER LEVEL	32	4		START	FINISH
	TIME	830	05		TIME	800 900
	DATE	12	0	12/10	DATE	12/0/97 12/10
CASING DEPTH						

DRILL RIG	S MCO Earth Probe 200	SURFACE CONDITIONS	Grass Area Near TVE
ANGLE	90°	BEARING	NORTHWEST FENCE LINE BETWEEN TVE
SAMPLE HAMMER TORQUE	~150 PSI FT.-LBS	EOTT & MARCO PROPERTIES	

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

1	28			(0-15) LOOSE, DUSKY yellowish BROWN (10% 2%), clayey silty, some FINE SAND, MINOR FeOx staining moist to damp (EX SOIL) (ML)						WATER @ 32" soil sample (P9-S-1) taken @ 15
2	30									Probe Refusal @ 32"
4				(15-28) Highly weathered, thinlY laminated, DARK yellowish orange (10% 6%), FINE GRAINED, VERY WEAK SANDSTONE, SOME FeOx staining.						Remove Auger (4") to Comp. Run Depth
5										↓
6										
7										
8				Observed mud zones during Auger run (Lithology changes?)						PID Readings:
9										Background: 0ppm
10										Sample Core: 0ppm
11				Completion Depth @ 203						
12										
14										
15										

DRILLING CONTR: **HYDRO LOGIC INC.**

LOGGED BY: **M. KELLER**

DATE: **12/10/97** CHK'D BY: **RSM**







# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>  <b>MID-AMERICA REFINERY CO. SITE</b>  N: 2766 DATUM E: -722 ELEVATION (NGVD) 927.6	DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>				BORING NO. <b>P-10</b>	
	SAMPLING METHOD: <b>CONTINUOUS</b> <b>SAMPLING USING 48" CORE TUBES</b> <b>AND LINERS</b>				SHEET <b>1 OF 1</b>	
	WATER LEVEL <b>4.5' BS</b>				START <b>TIME 1115</b>	FINISH <b>TIME 1145</b>
	TIME <b>1200</b>				DATE <b>12/9/97</b>	DATE <b>12/9/97</b>
	DATE <b>12/9/97</b>				DATE <b>12/9/97</b>	DATE <b>12/9/97</b>
	CASING DEPTH				DATE <b>12/9/97</b>	DATE <b>12/9/97</b>

DRILL RIG <b>SIMCO EARTHPOKE 200 (TRUCK MOUNT)</b>	SURFACE CONDITIONS <b>GLASS FEE SOUTH OF</b>
ANGLE <b>90°</b> BEARING	ASL GROVE CEMENT MAN OFFICE
SAMPLE HAMMER TORQUE <b>2150 PSI</b> FT.-LBS	

DEPTH IN FEET (ELEVATION)	PUN/ (RECOVERY)	SOIL GRAPH	WCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

1	①			(0-1.5) LOOSE BROWN SAND (SVR 2) OVER SITE TAKE IN SAND, MOST TO TAMP SPACES (CL)						INITIAL H-1000 P-10 Borehole: 0 ft Sample Core: 0 ft
2	①									
4				(1.5-7.5) SOFT TO FIRM, MODERATE BROWN (SVR 4) MOTTLED MEDIUM LIGHT GRAY (NG), Silty CLAY, TAKE TO SOME FINE-MED SAND, MNCV & FeO, STAINING, LUMPY, TAMP						WATER LEVEL @ 8.0' SOIL SAMPLE TO END @ 15' (P10-S-1)
5	①									
6	①									REFUSAL @ 5.5'
7	①									
8				(5-7.5) SAA						REFUSAL @ 5.5'
9	②			INCREASING SAND CONTENT W/ DEPTH						
10	②			(7.5-10) SOFT TO FIRM, MODERATE BROWN (SVR 4) CLAY SILT, SOME FINE GRAINED (SS CLASTS) MOST TO WET						REFUSAL @ 5.5'
11	②									
12	②			(10-35) SAA						REFUSAL @ 5.5'
13	②			VERY SOFT - NOT TONE						
14	②			(10-55) FIRM MODERATE BROWN (SVR 4) SILT, SOME CLAY LITE, STAINING, TAMP						REFUSAL @ 5.5'
15	②									

DRILLING CONTR **HYDROLOGIC INC.**  
 DON TUNNEY

LOGGED BY **M. KELLER**  
 DATE **12/9/97**



# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION KDHE / MARCO CI/KS 973-2300.4		DRILLING METHOD: DIRECT PUSH (Geoprobe Rg)		BORING NO. P-11	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: CONTINUOUS		SHEET 1 OF 2	
		SAMPLING USING 48" CORE TUBES AND LINERS		DRILLING	
		WATER LEVEL 90		START TIME 1615	FINISH TIME 830
		TIME 830		DATE 12/11	DATE 12/11
DATE 12/11		CASING DEPTH		DATE 12/11	
DATUM N: 2758 E: -373		ELEVATION 918.9 (NGVD)			

DRILL RIG SIMCO EarthProbe 200	SURFACE CONDITIONS GRASS AREA NEAR NATURAL
ANGLE 90° BEARING	GAS METERING STATION, ASH GROVE
SAMPLE HAMMER TORQUE ~150 PSI FT-LBS	PROPERTY

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	ACL REKT.	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1	①			(0-12) LOOSE, GRAYISH BLACK (112), SILT, LITTLE FINE SAND, BEGINNING LITHOLOGICAL (TOPSOIL), DAMP (ML)						
2	40/42		NR							
3										
4				(12-53) SOFT, MODERATE YELLOWISH BROWN (10YR 5/4), SILTY CLAY, LITTLE FN-MED SAND, FeOx/MNOx STAINING, DAMP (WET 4-45)						
5	②									
6	40/40		NR							
7										
8				(52-115) FIRM, MOTTLED MODERATE YELLOW BROWN (10YR 5/4) TO MEDIUM GRAY (1N5), SILTY CLAY, TR FINE SAND, DAMP TO WET (CL)						
9	③									Soil Sample P11-S-1 taken @ 85 1640
10	40/40		NR							WATER @ 90
11										
12	④			(115-160) BEGINNING PALE BROWN (5YR 5/6)						
13										
14	40/40		NR							
15										

DRILLING CONTR. HYDROLOGIC INC.

LOGGED BY M. KELLER

DATE 12/11 CLK'D BY RSM



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# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION KDHE / MARCO CI / KS 973-2300.4		DRILLING METHOD: DIRECT PUSH (GEOPROBE Rg)		BORING NO. P-11	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: CONTINUOUS		SHEET 2 OF 2	
		SAMPLING USING 48" CORE TUBES AND LINERS		DRILLING	
		WATER LEVEL		START	FINISH
		TIME		TIME	
		DATE		DATE	
DATUM		ELEVATION		CASING DEPTH	
1615		530		12/10	
12/11					

DRILL RIG	SINCO EARTHprobe 200	SURFACE CONDITIONS
ANGLE	90°	BEARING
SAMPLE HAMMER TORQUE	~150 PSI	FT.-LBS

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
							FROM	TO	
15									
14									
13									
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DRILLING CONTR HYDROLOGIC INC.

LOGGED BY M. KELLER

DATE CHK'D BY RSM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION KDHE / MARCO CI/KS 973-2300.4		DRILLING METHOD: DIRECT PUSH (Geoprobe Rg)		BORING NO. P-12	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: CONTINUOUS		SHEET 1 OF 2	
		SAMPLING USING 48" CORE TUBES AND LINERS		DRILLING	
		WATER LEVEL		START	FINISH
		TIME		1030	1115
DATE		DATE		DATE	
CASING DEPTH		CASING DEPTH		CASING DEPTH	
DRAIN E: 2951 ELEVATION 913.8 (NGVD)		SURFACE CONDITIONS GRASS AREA NEAR R.R. SPUR		DATE 12/11/97 12/11	
DRILL RIG EARTH PROBE 200		ANGLE 90° BEARING N.E. OF SANTA FE / ASH GROVE ROAD		SAMPLE HAMMER TORQUE 2150 PSI FT.-LBS	
INTERSECTIONS. WATER FORDING, IN AREA					

DEPTH IN FEET (ELEVATION)	PUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
							FROM	TO	
1	①			(0-25) FIRM, GRAYISH ORANGE (5YR 7/2), SILT, (KILN DUST), DAMP (ML)					
2	40/40			(25-30) BECOMING LIGHT BROWN (5YR 6/4)					
4	②			(32-39) SOFT TO FIRM, DUSKY BROWN (5YR 2/2), SILTY CLAY (TOPSOIL), TR. FN SAND, ORGANICS, MOIST TO DAMP (ML-CL)					
5	23/40								
6									
7									
8	③			(39-50) FIRM, MOTTLED MEDIUM YELLOWISH BROWN (10YR 5/4) & PALE BROWN (5YR 5/2), SILTY CLAY, SOME ROOTLETS, MOIST (CL)					
9	30/40								
10				(50-52) BECOMING GRAYISH BLACK (N2)					
11				(52-80) KILN DUST					
12	④			(80-94) SOFT TO V. SOFT, DUSKY BROWN (5YR 2/2), SILTY CLAY, LITTLE FN-MED. SAND, WET					
13	40/40								
14									
15									

WATER @ 5'

SAMPLE P12-S-1 TAKEN @ 5'

PHOTONUC PID READINGS

Background : 1.4 ppm

SAMPLE CORE : 1.4 ppm

DRILLING CONTR HYDRO LOGIC INC.

LOGGED BY M. KELLER

DATE CHK'D BY RSM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION KDHE / MARCO CI/KS 973-2300.4		DRILLING METHOD: DIRECT PUSH (GEOPROBE Rg)		BORING NO. P-12	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: CONTINUOUS		SHEET 2 OF 2	
		Sampling using 48" CORE TUBES AND LINERS		DRILLING	
		WATER LEVEL		START	FINISH
		TIME		TIME	TIME
DATE		DATE	DATE	DATE	DATE
CASING DEPTH		DATE	DATE	DATE	DATE

DRILL RIG	SURFACE CONDITIONS
ANGLE 90° BEARING	
SAMPLE HAMMER TORQUE ≈ 150 PSI FT.-LBS	

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET FROM TO	DESCRIPTION OF OPERATION AND REMARKS
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16	⑤			(9 1/2 - 13 1/2) FIRM, MOTTLED MOD. YELLOWISH BROWN (10 YR 5/4) & PALE BROWN (5 YR 5/2), SILTY CLAY, MOIST (CL)					
17	15/40								
18			NR	(13 1/2 - 15 1/2) HARD, VERY DUSKY RED (10 YR 2/2), CLAY, TRACE FN SAND, DAMP (CL-CH)					
19									
20	⑥			(15 1/2 - 20 1/2) SOFT TO FIRM, MOTTLED MOD. YELLOWISH BROWN (10 YR 5/4) & PALE BROWN (5 YR 5/2), SILTY CLAY, SOME SAND,					
21	28/28		SR						
22				DAMP TO WET (CL)					WET ZONE @ 17 1/2
23				(20 1/2 - 22 1/2) VERY SOFT					
9				(22 1/2 - 22 3/4) HIGHLY WEATH., MOD. BROWN (5 YR 3/4), FINE GRAINED, VERY WEAK, SANDSTONE					
10									
11									
12									
13									
14									
15									

\* SOME OF THE S.S CEMENTATION MATRIX IS SLIGHTLY REACTIVE TO HCL

DRILLING CONTR HYDROLOGIC INC.

LOGGED BY M. KELLER

DATE CHK'D BY RSM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION KDHE / MARCO CI/KS 973-2300.4		DRILLING METHOD: DIRECT PUSH (GEOPROBE Rg)		BORING NO. P-13	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: CONTINUOUS		SHEET 1 OF 2	
		Sampling using 48" CORE TUBES AND LINERS		DRILLING	
		WATER LEVEL 30		START	FINISH
		TIME 1811		TIME 1800	TIME 1845
DATE 12/13		DATE 12/13		DATE 12/13	
CASING DEPTH					

DRILL RIG SIMCO Earthprobe 200		SURFACE CONDITIONS TASCHE VACANT LOT EAST	
ANGLE 90° BEARING		# BUILDINGS.	
SAMPLE HAMMER TORQUE ≈ 150 PSI FT.-LBS			

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	REL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

1	①			(0-15?) SOFT, DUSKY yellowish BROWN (10yr 2/2), clayey SILT, LITTLE FINE MED SAND, damp (Topsoil)						<p>SAMPLE P13-S-1 TAKEN @ 15</p> <p>WATER @ 3'</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>PHOTOVAC PID READINGS</p> <p>BACKGROUND: 1.5 PPM</p> <p>SAMPLE CORE: 1.5 PPM</p> </div>
2	10/40			(ML-CL)						
3				(15?-18') SOFT TO FIRM, olive gray (5yr 4/1), silty clay, TR FINE SAND, FEOx staining locally, damp						
4	②			(CL)						
5	40/50			(18'-19') LOOSE, pale brown (5yr 4/2), sandy chest gravel, LITTLE clay and silt, damp to wet						
6				(GM-GC)						
7	③			(19'-19.5') LOOSE, dark yellowish brown (10yr 4/2), poorly graded, med. SAND, LITTLE silt and clay, damp to wet						
8	30/40			(SC-SM)						
9				(19.5'-19.5') highly weathered, dark yellowish orange (10yr 6/1), med graded, VERY WEAK, SANDSTONE						
10										
11										
12										
13										
14										
15										

DRILLING CONTR HydroLogic Inc.

LOGGED BY M. KELLER

DATE CHK'D BY LJM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <div style="font-size: 1.2em; font-family: cursive;">KDHE / MARCO CI / KS</div> <div style="font-size: 1.2em; font-family: cursive;">973-2300.4</div>		DRILLING METHOD: <span style="font-size: 1.2em; font-family: cursive;">DIRECT PUSH</span> <div style="font-size: 1.2em; font-family: cursive;">(GEOPROBE Rq)</div>				BORING NO. <div style="font-size: 1.5em; font-family: cursive;">P-13</div>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <span style="font-size: 1.2em; font-family: cursive;">CONTINUOUS</span> <div style="font-size: 1.2em; font-family: cursive;">Sampling using 48" CORE TUBES</div> <div style="font-size: 1.2em; font-family: cursive;">AND LINERS</div>				SHEET <div style="font-size: 1.5em; font-family: cursive;">2 OF 2</div>	
		WATER LEVEL				DRILLING	
		TIME				START      FINISH TIME      TIME	
		DATE				DATE      DATE	
DATUM		CASING DEPTH				DATE	

DRILL RIG				SURFACE CONDITIONS				
ANGLE 90° BEARING								
SAMPLE HAMMER TORQUE ≈ 150 PSI FT.-LBS								
DEPTH IN FEET (ELEVATION)	(RECOVERY)	SOIL GRAPH	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET	DESCRIPTION OF OPERATION AND REMARKS
							FROM	

16	④ 40 40	NR					
17							
18	⑤ 25 25	NR					
19							
20							probe REFUSAL @ 195
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

DRILLING CONTR

LOGGED BY M. KELLER

DATE \_\_\_\_\_ CHK'D BY LSM



# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(Geoprobe Rg)</b>		BORING NO. <b>P-14</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1</b> OF <b>2</b>	
		<b>SAMPLING USING 48" CORE TUBES AND LINES</b>		DRILLING	
		WATER LEVEL <b>4.5</b>		START	FINISH
		TIME <b>10:15</b>	TIME <b>1:00</b>		
DATE <b>12/12</b>		DATE <b>12/12/17</b>	DATE <b>12/12</b>		
DATUM E: <b>476</b>		ELEVATION <b>914.2</b> (NGVD)		CASING DEPTH	
DRILL RIG <b>SILCO FA-4000E 200</b>		SURFACE CONDITIONS <b>NE CORNER OF CERKLE SHAP</b>			
ANGLE <b>90°</b>		BEARING		YARD <b>FAIR</b> <b>UNDETV</b>	
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT-LBS					

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACTION	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1	①			(0-13) FIRM, GRAYISH BROWN (SYR 3/4) SILTY CLAY, SOME MED-GRADE SAND SHAP, MEDIAL (FILL)						SAMPLE P14-S-1 - ALONG 2-5
2	32/42			(13-55) SOFT TO FIRM, GRAYISH BLACK (N2), SILTY CLAY, SOME MED-GRADE SAND, SOME FINE GRAVEL, INTERMIXED WITH FILL DEBRIS & ORGANICS, DAMP TO WET (FILL)						WATER @ 33
4	②			(55-80) FIRM TO HARD, SLURRY BLACK (SY 2/4), SILTY CLAY, ORGANICS, DAMP (CL)						NO PROXIMITY NOT OF WATER.
5	34/40			(80-92) SOFT, FINE (N2) GRAVELLY CLAY, LITTLE MED SAND, WET (GC)						FLUORAC PID READINGS: RECORDS 1.0 ppm SAMPLE CORE: 1.0 ppm
6				(92-127) STIFF, MEDIUM DARK GRAY, SILTY CLAY, LITTLE MED SAND, WET TO DAMP (CL-CH)						*NO RECOVERY RUN 4
7										
8										
9										
10										
11										
12										
13										
14										
15										







# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS 973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH (Geoprobe Ry)</b>		BORING NO. <b>P-14</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>2 OF 2</b>	
		<b>Sampling using 48" CORE TUBES AND LINERS</b>		DRILLING	
		WATER LEVEL		START	FINISH
		TIME		TIME	TIME
		DATE		DATE	DATE
DATUM		ELEVATION		CASING DEPTH	

DRILL RIG	SURFACE CONDITIONS	
ANGLE <b>90°</b>	BEARING	
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT.-LBS		

DEPTH IN FEET (ELEVATION)	PUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

16				(67-19°) SOFT TO FIRM, GRAYISH BROWN (M2), SILTY CLAY, LITTLE FN GRAVEL, SOME ORGANICS/WOOD CHIPS, WET						
17	5			(CL-OH)						
18	3 1/2 4°			(198-225°) SOFT TO FIRM, LIGHT OLIVE GRAY (SY 6/1), SILTY CLAY, SOME FN SAND, WOOD CHIPS						
20										
22	6			(225-234°) LOOSE, DARK YELLOWISH ORANGE (10yr 6/6) SAND, SOME SILT, CLEAN, POORLY GRADED, WET						
23	3 1/2 3 1/2									
24				(234-242°) LOOSE, PALE BROWN (SYR 8/2) DIRECT GRAVEL AND SAND, SOME SILT, SOME TO WET						
25	1 1/2 1 1/2			(GM)						
26				(242-255°) MASSIVE, LIGHT OLIVE GRAY (SY 6/1), HARD, GRAVEL, VERY WEAK, SANDSTONE						
12										
14										
15										

DRILLING CONTR **HYDROLOGIC INC.**

LOGGED BY **M. KELLER**

DATE **CSM** CHK'D BY





FIELD LOG - SOIL BOREHOLE											
SITE NAME AND LOCATION KDHE / MARCO CI/KS 973-2300.4  MID-AMERICA REFINERY CO. SITE				DRILLING METHOD: DIRECT PUSH (GEOPROBE Rg)				BORING NO. P-15			
								SHEET 1 OF 2			
				SAMPLING METHOD: CONTINUOUS Sampling using 48" CORE TUBES AND LINERS				DRILLING			
				WATER LEVEL 2'				START TIME 1500	FINISH TIME 1545		
				TIME 1544							
DATE 12/13				DATE 12/13		DATE 12/13/97					
DATUM N: 1871 E: 355 ELEVATION 912.7 (NGVD)				CASING DEPTH							
DRILL RIG SIMCO Earthprobe 200				SURFACE CONDITIONS SCRAP YARD ON BERKE							
ANGLE 90° BEARING				PROPERTY EAST OF MAIN BUILDING							
SAMPLE HAMMER TORQUE ≈ 150 PSI FT.-LBS				BARE WET ground							
DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	pHCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL		SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
									FROM	TO	

DRILLING CONTR

			Pie - probe TO 3'				CORE DEPTH TO ~ 22'	SAMPLE PIS-S-1 TAKEN @ 21'
1								
2								
3	(1)		(3' - 5') MISCELLANEOUS FILL & DEBRIS					
4	22 / 40	NR	(5' - 9')	SOFT, GRAYISH BLACK (NZ), SILTY CLAY, TR. FN SAND, LAMP				
5			(CL)					
6								
7	(2)		(9' - 21')	SOFT TO FIRM, MOTTLED OLIVE GRAY (SY 4/1) TO DARK YELLOWISH ORANGE (10YR 6/6), SILTY CLAY, TR. FN-MED SAND, FeOx STAINING, LAMP				
8	40 / 40	NR	(CL)					
9								
10								
11								
12	(3)							
13	30 / 40	NR						
14								
15								

LOGGED BY M. KELLER

DATE \_\_\_\_\_ CHK'D BY RSN





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION  
KDHE / MARCO CI/KS  
973-2300.4

MD-AMERICA REFINERY CO. SITE

DRILLING METHOD: DIRECT PUSH  
(GEOPROBE Rg)

BORING NO.  
P-15

SAMPLING METHOD: CONTINUOUS

SHEET  
2 OF 2

SAMPLING USING 48" CORE TUBES  
AND LINERS

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

DATE

DATE

CASING DEPTH

DATE

DATUM

ELEVATION

DRILL RIG

SURFACE CONDITIONS

ANGLE 90°

BEARING

SAMPLE HAMMER TORQUE ≈ 150 PSI FT.-LBS

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
							FROM	TO	

16	④			(218-225) LOOSE, PALE YELLOWISH BROWN (10yr 6/2), CLAY SAND, LITTLE CLAY, (100% GRADED SAND), Damp TO WET (SM)					
17	3°/4°								
18									
19									
20	⑤			(225-228) LOOSE, PALE BROWN (5yr 5/2), SANDY CLAY GRAVEL, LITTLE CLAY AND SILT, Damp TO WET (GM-GL)					
21	4°/4°								
22									
23									
9				(228-229) Highly weathered, Dark yellowish orange (10yr 6/2), MED GRAINED, VERY WEAK, SANDSTONE					probe REFUSAL @ 23°
10									
11				(229-230) Highly weath, thinly laminated, MED DARK GRAY (NY), VERY WEAK SHALE					
12									
13									
14									
15									

DRILLING CONTR. HYDROLOGIC INC.

LOGGED BY M. KELLER

DATE CHK'D BY RSM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(Geoprobe Rg)</b>		BORING NO. <b>P-16</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1 OF 2</b>	
		<b>Sampling using 48" CORE TUBES</b>		DRILLING	
		<b>AND LINERS</b>		START	FINISH
		WATER LEVEL		TIME	TIME
DATE				DATE	DATE
CASING DEPTH				DATE	DATE
N: 1534 DATUM E: 271		ELEVATION <b>914.0</b> (NGVD)			
DRILL RIG <b>SINCO FAIRBANKS 2000</b>		SURFACE CONDITIONS <b>RAVINE EDGE OF</b>			
ANGLE <b>90°</b> BEARING		<b>SEECKE ROAD (RD) - RACE ROAD</b>			
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT.-LBS					

DEPTH IN FEET (ELEVATION)	FIN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1				(0-35) Silt - FFM, MUCKY YELLOWISH BROWN (10yr 3/4) STAINY CLAY - NO TO SAND (FLL)						GRAVEL MATERIAL 0-25" - STRONGLY REACTIVE TO HCL.
2				(35-? - 165) Silt - Greenish Black (Silt 1/4) S - CLAY, SOME GRAVEL, SOME MED. SAND, WE - (FLL?) (CL)						WATER @ 35' SAME 10-5-1 - 10-5-3
3										
4										
5										
6				(165-211) FFM, MUCKY YELLOWISH BROWN (10yr 4 1/2) S - CLAY, SOME MED SAND TO 20-21" WE - (CL-SC)						PROBABLE FILL REMAINS BACKFILL: 1.4 MM SAMPLE CORE: 1.3 MM
7										
8										
9										
10				(211-227) Silt - MUCKY BROWN (10yr 4 1/2) F - CLAY, SOME MED SAND TO 20-21" WE - (CL-SC)						* NO RECOVERY FROM 21"
11										
12										
13										
14										
15										

DRILLING CONTR **HydroLogic Inc.**

LOGGED BY **M. KELLER**

DATE **12/12/97** CHK'D BY **PSM**



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FIELD LOG - SOIL BOREHOLE																	
SITE NAME AND LOCATION				DRILLING METHOD:				BORING NO.									
KDHE / MARCO CI/KS 973-2300.4  MID-AMERICA REFINERY CO. SITE				DIRECT PUSH				P-16									
				(GEOPROBE Rg)				SHEET									
				SAMPLING METHOD: CONTINUOUS				2 OF 2									
				SAMPLING USING 48" CORE TUBES				DRILLING									
				AND LINERS				START		FINISH							
WATER LEVEL				TIME		TIME		DATE		DATE							
TIME				1144		1226		12/17		12/12							
DATE				DATE		DATE		DATE		DATE							
CASING DEPTH				DATE		DATE		DATE		DATE							
DATUM				ELEVATION				CASING DEPTH									
DRILL RIG				SURFACE CONDITIONS													
ANGLE 90°				BEARING													
SAMPLE HAMMER TORQUE				≈ 150 PSI				FT.-LBS									
DEPTH IN FEET (ELEVATION)		PUN # (RECOVERY)		SOIL GRAPH		SAMPLE NUMBER AND DESCRIPTION OF MATERIAL		SAMPLER AND BIT		CASING TYPE		BLOWS/FOOT ON CASING		DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS	
												FROM		TO			
17		40		NR													
18		40		NR													
19		40		NR													
20		40		NR													
21		40		NR													
22		40		NR													
23		40		NR													
24		40		NR													
25		40		NR													
26		40		NR													
27		40		NR													
28		40		NR													
29		40		NR													
30		40		NR													
31		40		NR													
32		40		NR													
33		40		NR													
34		40		NR													
35		40		NR													
36		40		NR													
37		40		NR													
38		40		NR													
39		40		NR													
40		40		NR													
41		40		NR													
42		40		NR													
43		40		NR													
44		40		NR													
45		40		NR													
46		40		NR													
47		40		NR													
48		40		NR													
49		40		NR													
50		40		NR													
51		40		NR													
52		40		NR													

DRILLING CONTR

LOGGED BY M. KELLER

DATE \_\_\_\_\_ CLK'D BY RSM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS 973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH (Geoprobe Rg)</b>		BORING NO. <b>P-17</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1 OF 2</b>	
		<b>Sampling using 48" CORE TUBES AND LINERS</b>		DRILLING	
		WATER LEVEL <b>2 3</b>		START	FINISH
		TIME <b>1815</b>		TIME	TIME
DATE <b>12/11</b>		DATE	DATE	DATE	
CASING DEPTH				12/11/97 12/11	
N: 2612 DATUM E: 664		ELEVATION (NGVD) <b>911.5</b>			
DRILL RIG <b>KIMCO Earthprobe 200</b>		SURFACE CONDITIONS <b>MARSH AREA South of</b>			
ANGLE <b>90°</b> BEARING		<b>Ash Grove Road</b>			
SAMPLE HAMMER TORQUE <b>2150 PSI</b> FT.-LBS					

DEPTH IN FEET (ELEVATION)	PUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET FROM TO	DESCRIPTION OF OPERATION AND REMARKS
1	①			(0-12) LOOSE, DUSKY BROWN (SYR 7/2), CLAYEY GRAVEL, SOME SILT, (ROADBASE) DAMP TO WET (6C)					SAMPLE P17-S-1 TAKEN @ 3'
2	25/40			(12-4?) FIRM TO HARD DUSKY, YELLOWISH BROWN (10YR 7/2) SILTY CLAY, TR FINE TO COARSE SAND DAMP TO WET (CL)					
4	②			(? - 13E) SOFT TO FIRM, BROWNISH BLACK (SYR 7/1), SILTY CLAY, LITTLE MED. SAND, DAMP (CL)					
5	08/52			(13E-17E) STIFF TO HARD MOTTLED MED. DARK GRAY (N5), & PALE BROWN (SYR 5/2), SILTY CLAY, SOME FIN SAND, FeOx STAINING, DAMP (CL)					
6									<div> RUNS 2 &amp; 3 HAD POOR RECOVERY, LITHOLOGIES ARE INFERRED FROM 4-13'. </div> <div> PHOTOVAC AD READINGS:  BACKGROUND: 1.3 ppm  SAMPLE CORE: 1.3 ppm </div>
7									
8									
9									
10	③								
11	10/40								
12									
13									
14	④								
15									

DRILLING CONTR **Hydro Logic Inc.**

LOGGED BY **M. KELLER**

DATE **CHK'D BY**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>		BORING NO. <b>P-17</b>		
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>2</b> OF <b>2</b>		
		<b>Sampling using 48" CORE TUBES</b>		DRILLING		
		<b>AND LINERS</b>		START	FINISH	
		WATER LEVEL	2 1/2			TIME
DATE		12/11			DATE	DATE
CASING DEPTH					12/11	12/11

DRILL RIG	SURFACE CONDITIONS
ANGLE <b>90°</b> BEARING	
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT.-LBS	

DEPTH IN FEET (ELEVATION)	Pun# (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

16	38	40	NR	(17' - 19') SAA BELOWING DARK YELLOWISH BROWN (10YR 4/2) (CL)						
18	40	40	NR	(19' - 25') DIFF, MOTTLED MED DARK GRAY (NS) & PALE BROWN (5YR 5/2) Silty CLAY, LITTLE FN SAND, DAMP (CL)						
22	40	40	NR	SANDY GRAVEL LAYERS AT 19'-19 1/2' & 23'						
23	40	40	NR	(25' - 25 1/2') MODERATELY WEATHERED, DUSKY BLUE (5PB 3/2), FINE GRAINED, WEAK, SANDSTONE.						
25				PROBE REFUSAL @ 25'						
11										
12										
14										
15										

DRILLING CONTR **HYDRO LOGIC INC.**

LOGGED BY **M. KELLER**

DATE **12/11** CHK'D BY **CSM**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION

KDHE / MARCO CI/KS  
973-2300.4

DRILLING METHOD:

DIRECT PUSH  
(GEOPROBE Rg)

BORING NO.

P-18

SAMPLING METHOD:

CONTINUOUS

SHEET

1 OF 2

SAMPLING USING 48" CORE TUBES  
AND LINERS

DRILLING

START

FINISH

WATER LEVEL

4'

TIME

1430

TIME

1445

DATE

12/9

DATE

12/9

CASING DEPTH

N: 2375

DATUM E: 775

ELEVATION 911.3

(NGVD)

DRILL RIG SIMCO Earthprobe 200 (TRUCK MOUNT)

SURFACE CONDITIONS

MARSH OPEN AREA

ANGLE

90°

BEARING

EASTWARD EDGE

SAMPLE HAMMER TORQUE

~150 PSI FT-LBS

DEPTH IN FEET (ELEVATION)	RUN/ (RECOVERY)	SOIL GRAPH	HCL FRACTION	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

1	30/30		NR	(0-0.5) LOOSE TO FIRM, GRAYISH BLACK, SILT (CL-SOIL), ORGANIC TAMP (ML)						
2	30/30		NR	(0.5-3.0) FIRM TO SOFT, GRAYISH BLACK (NO2), SILT CLAY, R FINE-MED SAND, TAMP TO WET (CL)						
3										
4	20/20		NR	(3.5-14.0) SOFT TO HARD, GRAY SH BLACK (NO2) CLAY SOME SILT, SOME FINE-MED SAND, TAMP TO WET (CL-CH)						
5	20/20		NR							
6	20/20		NR							
7										
8										
9										
10	35/55		NR	(14.0-16.0) STIFF TO HARD, PALE BROWN (BYR 5/2), SILT CLAY, LITTLE FN SAND TAMP (CL)						
11	35/55		NR							
12	35/55		NR							
13										
14										
15										

WATER LEVEL @ 4'  
SOIL SAMPLE TAKEN @ 3'  
(PB-S-1)

NO CORE WAS RECOVERED  
DURING RUN 2. THE CORE  
TUBE WAS RE-PUSHED TO  
0.5'

Photo of H. 10 p. 11-12  
P. 10-11  
SAMPLING 10 PM  
TIME CORE 10 PM

DRILLING CONTR HYDROLOGIC INC.

LOGGED BY M. KELLER

DATE CHK'D BY PSM







# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>  <b>MID-AMERICA REFINERY CO. SITE</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>				BORING NO. <b>P-18</b>	
						SHEET <b>2 OF 2</b>	
		SAMPLING METHOD: <b>CONTINUOUS</b> <b>SAMPLING USING 48" CORE TUBES</b> <b>AND LINERS</b>				DRILLING	
		WATER LEVEL TIME DATE CASING DEPTH				START TIME DATE	FINISH TIME DATE
DATUM ELEVATION				SURFACE CONDITIONS <b>Marsh with pond</b>			
DRILL RIG <b>S.M.C.O. FARMHOUSE 200</b>		ANGLE <b>90°</b>		BEARING <b>PALMAD S.W.</b>			
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS					

DEPTH IN FEET (ELEVATION)	PUN/ (RECOVERY)	SOIL GRAPH	NCL Reaction	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
15				(19.0-19.5) Soft to Firm, Grayish Black (NS), Silty Clay, some fine-med sand damp to wet (CL)						
16				(19.5-20.0) SAME AS 19.0-19.5						
17				(20.0-21.3) Soft, Brownish Gray (SYR 4/1) clayey sand, damp (SC)						
18										
19										
20										
21										
22				(21.3-21.8) chert gravel, some clay, some silty wet (GC-GM)						
23										
24										
25										

DRILLING CONTR **HYDRO LOGIC INC.**

LOGGED BY **M. KELLER**

DATE **12/9** CHK'D BY **12/9**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS</b> <b>973-2300.4</b>		DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE Rg)</b>		BORING NO. <b>P-19</b>	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: <b>CONTINUOUS</b>		SHEET <b>1 OF 2</b>	
		<b>Sampling using 48" CORE TUBES</b>		DRILLING	
		<b>AND LINERS</b>		START	
		WATER LEVEL <b>35</b>		TIME <b>1455</b>	
TIME <b>1545</b>		DATE <b>12/11</b>		DATE <b>12/11</b>	
DATE <b>12/11/07</b>		CASING DEPTH		DATE <b>12/11</b>	
V: 2012 DATUM E: 915		ELEVATION (NOVD) <b>911.8</b>		SURFACE CONDITIONS <b>Mud Area South of Pail</b>	
DRILL RIG <b>SINCO Earthprobe 700</b>		ANGLE <b>90°</b>		BEARING	
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS		SPILL & RAIL SPILL INTERSECTION	

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACTION	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1	①			(0-02) SOFT TO FIRM, GRAYISH B/LK (N2), SILT, SOME CLAY AND FN GRAVEL, ORGANIC MATERIAL, DAMP (ML)						CORE SLAVE WET ~ 4', sample P19-S-1 TAKEN @ 3'
2	①			(02-33?) FIRM, GRAYISH B/LK (N2), SILTY CLAY, TR FINE SAND, DAMP TO WET (CL)						
4	②			(79°-170°) STIFF TO HARD MOTTLED MED. DARK GRAY (N5) & PALE BROWN (5YR 5/6), SILTY CLAY, SOME FN SAND, FeOx STAINING, DAMP (CL)						* NO CORE WAS RECOVERED DURING RUN 2. THE CORE TUBE WAS RE-PUSHED TO 92.
5	②			(17°-19°) SOFT, DARK GRAY (N3), SILTY CLAY, SOME SAND, DAMP TO WET, SOME SAND LENSES (CL)						
6	③									PHOTOVAC PID READINGS: Background: 47 pph SAMPLE CORE: 1.7 pph
7	③									
8	④									
9	④									
10	④									
11	④									
12	④									
13	④									
14	④									
15	④									

DRILLING CONTR **HYDROLOGIC INC.**

LOGGED BY **M. KELLER**

DATE **12/11/07** CHK'D BY **CSM**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI/KS 973-2300.4</b>	DRILLING METHOD: <b>DIRECT PUSH</b>				BORING NO. <b>P-19</b>	
	<b>(Geoprobe Rg)</b>				SHEET <b>2 OF 2</b>	
	SAMPLING METHOD: <b>CONTINUOUS</b>				DRILLING	
	<b>Sampling using 48" CORE TUBES</b>				START	FINISH
	<b>AND LINERS</b>				TIME	TIME
MID-AMERICA REFINERY CO. SITE	WATER LEVEL				1455	1540
	TIME					
	DATE				DATE	DATE
					12/11/97	12/11
DATUM	ELEVATION			CASING DEPTH		

DRILL RIG	SURFACE CONDITIONS	
ANGLE <b>90°</b>	BEARING	
SAMPLE HAMMER TORQUE <b>~150 PSI</b> FT.-LBS		

DEPTH IN FEET (ELEVATION)	(RECOVERY)	SOIL GRAPH	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
							FROM	TO	

16	4p 4p	NR	(19' - 20') FIRM, LIGHT BROWN (5yr 5/6) TO PALE BROWN (5yr 5/2), CLAYEY SAND TO SANDY CLAY, SOME SILT, DAMP (SC)						
17									
18	5p 4p	NR	(20' - 21') LOOSE, PALE BROWN (5yr 5/2), CHERT GRAVELLY SAND, SOME SILT, LITTLE CLAY, DAMP TO WET (SM-SC)						
19									
20									
21									Probe REFUSAL @ 21'
22									
23									
24									
25									

DRILLING CONTR **HYDROLOGIC INC.**

LOGGED BY **M. KELLER**

DATE **12/11/97** CHK'D BY **PSM**





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION KDHE / MARCO CI / KS 973-2300.4		DRILLING METHOD: DIRECT PUSH (GEOPROBE R <sub>g</sub> )		BORING NO. P-20	
MID-AMERICA REFINERY CO. SITE		SAMPLING METHOD: CONTINUOUS		SHEET 1 OF 2	
N: 2240 E: 253 ELEVATION 913.2 (NGVD)		SAMPLING USING 48" CORE TUBES AND LINERS		DRILLING	
DATING		WATER LEVEL 3'		START	FINISH
		TIME 1707		TIME 1635	TIME 1720
		DATE 12/13		DATE 12/13/97	DATE 12/13
CASING DEPTH					
DRILL RIG SIMCO Earthprobe 200		SURFACE CONDITIONS VACANT LOT BETWEEN			
ANGLE 90° BEARING		GERICK & TACKLY PROPERTIES			
SAMPLE HAMMER TORQUE ~150 PSI FT.-LBS					

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACTIVITY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	
1	①			(0-25) SOFT, DUSKY YELLOWISH BROWN (10YR 2/2), CLAYEY SILT, LITTLE MED SAND, DAMP (TOPSOIL/FILL) (ML)						SOIL SAMPLE PRO-S-1 TAKEN @ 120" INITIAL WATER @ 130"
2	28/40									
3				(25-?) SOFT, BROWNISH BLACK (5YR 2/1), SILTY CLAY TO CLAYEY SILT, TR MED SAND, DAMP (ML-CL)						* RUNS 2 & 3 HAD NO RECOVERY. CORE BARRELS & RODS ARE COMING TO THE SURFACE WITH PETROLEUM PRODUCT ON THEM
4	②									
5				(?-128) SOFT, MEDIUM DARK GRAY (N4), SILTY CLAY, DAMP TO WET, PETROLEUM SATURATED (CL)						Petrovac PID Readings: Background: 1.6 ppm Core Sample @ 25 = 70 ppm 120 = 500 ppm 185 = 40 ppm
6	0/40									
7				(128-178) FIRM, MOTTLED LIGHT OLIVE GRAY (5Y 4/1) TO DARK YELLOWISH ORANGE (10YR 6/6), SILTY CLAY, TR F-MED SAND, FeOx STAINED, WET (CL)						S-PENG ODOR
8	③									
9	0/30									
10										
11										
12	④									
13	40/40									
14										
15										

DRILLING CONTR HYDROLOGIC INC.

LOGGED BY M. KELLER

DATE CHK'D BY RSM





# FIELD LOG - SOIL BOREHOLE

SITE NAME AND LOCATION <b>KDHE / MARCO CI / KS</b> <b>973-2300.4</b>  <b>MID-AMERICA REFINERY CO. SITE</b>	DRILLING METHOD: <b>DIRECT PUSH</b> <b>(GEOPROBE R<sub>g</sub>)</b>				BORING NO. <b>P-20</b>	
					SHEET <b>2 OF 2</b>	
	SAMPLING METHOD: <b>CONTINUOUS</b>					
	Sampling using <b>48" CORE TUBES</b> <b>AND LINERS</b>				DRILLING	
	WATER LEVEL				START TIME	FINISH TIME
	TIME				DATE	DATE
DATUM		ELEVATION		CASING DEPTH		

DRILL RIG	SURFACE CONDITIONS	
ANGLE <b>90°</b>	BEARING	
SAMPLE HAMMER TORQUE <b>~150 PSI</b>		FT.-LBS

DEPTH IN FEET (ELEVATION)	RUN # (RECOVERY)	SOIL GRAPH	HCL REACT	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	DEPTH IN FEET		DESCRIPTION OF OPERATION AND REMARKS
								FROM	TO	

16	⑤			(178-184) Loose, Pale Brown (5YR 5/2) silty SAND, poorly sorted, little clay, damp to wet (SM)						
17	40									
18	40									
19				(184-189) loose, med gray (NS), sandy chert gravel, little clay, damp to wet (GC)						
20				(189-194) lightly weathered, pale yellowish orange (10YR 6/6), medium grained, very weak, sandstone						
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

DRILLING CONTR Hydro Logic Inc.

LOGGED BY M. KELLER

DATE 12/5/7 CHK'D BY 12/5/7





**APPENDIX F**

**MONITOR WELL CONSTRUCTION SUMMARIES**



Well No. P-2  
Boring No. X-Ref: P-2

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
Top of Casing \_\_\_\_\_

**Drilling Summary:**

Total Depth 21.7  
Borehole Diameter 2.75"  
Casing Stick-up Height: \_\_\_\_\_  
Driller Hydrologic Inc.  
Rig SIMCO RMT-1000E 200  
Bit(s) 2.75" BEHC POINT  
Drilling Fluid \_\_\_\_\_  
Protective Casing FLUSH POINT

**Construction Time Log:**

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	12/12	15:00	12/12	16:30
Geophys. Logging				
Casing:		16:30		16:40
Filter Placement:		16:40		16:55
Cementing:		16:55		17:00
Development:		18:20		18:31

**Well Design & Specifications**

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
Casing String (s): C = Casing S = Screen.

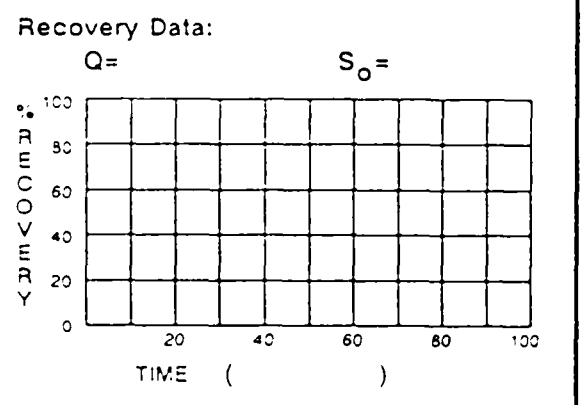
Depth	String(s)	Elevation
21.05	11.25	-
1.05	0	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
Casing: C1	1" ID PVC	
C2		
Screen: S1	1" ID PVC 10-50	
S2		
Filter Pack:	1-100 # 40/70	
	21.25 - 8.5	
Grout Seal:		
Bentonite Seal:	6-100 # 10 VAS 200	
	21 - 12	

**Well Development:**

Flow = 1000 L/min @ 100 ft  
primed for sampling

**Stabilization Test Data:**

Time	pH	Spec. Cond.	Temp (C)
18:00	7.23	2500	53.4
18:05	7.25	2500	53.0
18:10	7.28	2500	53.4
18:15	7.27	2500	53.2



**Comments:** MEASUREMENTS QGS

SITE NAME MARCO LOCATION CHUTE, KANSAS  
SUPERVISED BY M. KELLER DATE \_\_\_\_\_



Well No. P-4  
Boring No. X-Ref: P-4

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
Top of Casing \_\_\_\_\_

## Drilling Summary:

Total Depth 223  
Borehole Diameter 2.25  
Casing Stick-up Height: FLUSH  
Driller D. DILLANEY  
HYDROLOGIC INC.  
Rig SIMCO Earthphor 200  
Bit(s) 2.25" DRIVE POINT  
Drilling Fluid \_\_\_\_\_  
Protective Casing FLUSH MOUNT

## Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
<u>2187</u> - <u>1187</u>	<u>S1</u>	-
<u>123</u> - <u>0</u>	<u>C1</u>	-
-	-	-
-	-	-
-	-	-
-	-	-

Casing: C1 1" ID PVC  
C2 \_\_\_\_\_  
Screen: S1 1" ID PVC 0.50" S  
S2 \_\_\_\_\_

Filter Pack: 12-40 GRIT SAND  
2187 - 105  
Grout Seal: \_\_\_\_\_  
Bentonite Seal: ENVIROLINE 11A 25'  
BENTONITE  
105 - 12

## Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	<u>12/13/17</u>	<u>0955</u>	<u>12/13</u>	<u>1050</u>
Geophys. Logging	-	-	-	-
Casing:	-	<u>1050</u>	-	<u>1100</u>
Filter Placement:	-	<u>1150</u>	-	<u>1150</u>
Cementing: <u>BET</u>	-	-	-	-
Development:	-	-	-	-

## Well Development:

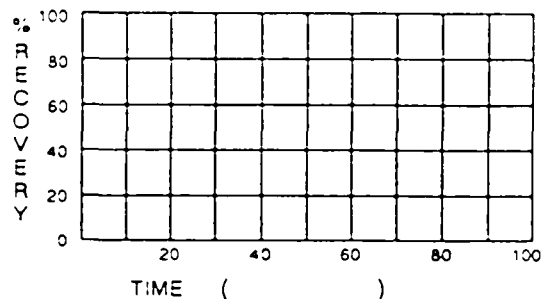
REMOVED 4 gallons 5 sec vol  
back to sampling

## Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
<u>1137</u>	<u>7.08</u>	<u>1580</u>	<u>20.4</u>
<u>1140</u>	<u>7.00</u>	<u>1500</u>	<u>20.8</u>
<u>1142</u>	<u>6.90</u>	<u>1500</u>	<u>20.8</u>
<u>1144</u>	<u>6.80</u>	<u>1520</u>	<u>20.2</u>

## Recovery Data:

Q= \_\_\_\_\_ S<sub>0</sub>= \_\_\_\_\_



Comments: 11/13/2017 COMMENTS RGS

SITE NAME MARCO LOCATION CHUTE, KANSAS  
SUPERVISED BY M. KELLER DATE \_\_\_\_\_



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Well No. P-6  
Boring No. X-Ref: P-6

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
Top of Casing \_\_\_\_\_

## Drilling Summary:

Total Depth 155  
Borehole Diameter 4" AUGER  
Casing Stick-up Height: \_\_\_\_\_  
Driller JOHNEY  
HYDROLOGIC INC.  
Rig SMITH F-1000E T-100  
Bit(s) 2 7/8" DIA. POINT  
Drilling Fluid \_\_\_\_\_  
Protective Casing FLASH

## Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	12/13/84	9:15	12/13	9:45
Geophys. Logging				
Casing:		9:45		9:50
Filter Placement:		2:50		9:00
Cementing: <u>BENT</u>		9:00		9:10
Development:		9:15		9:30

## Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
0 - 55	C1	-
55 - 100	C1	-
100 - 155	C1	-

Casing C1 1" ID PVC  
C2 \_\_\_\_\_  
Screen S1 1" ID PVC 10-56P  
S2 \_\_\_\_\_

Filter Pack: 12-40 GRIT SAND  
155 - 3'  
Grout Seal: \_\_\_\_\_  
Bentonite Seal: EMULSION MBS. ORT  
BENTONITE  
22 - 1'

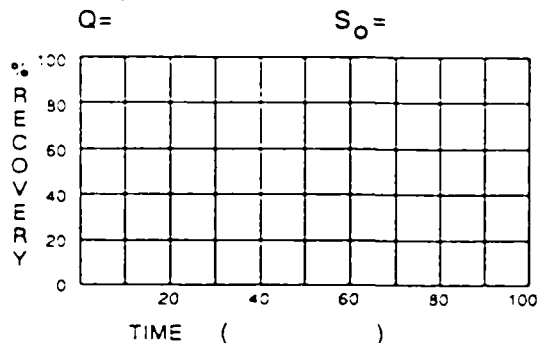
## Well Development:

Developed to 155' depth  
100% recovery

## Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
15:55	7.5	1730	11.5
16:05	7.5	1778	11.5
16:15	7.5	1778	11.5
16:25	7.5	1730	11.5
16:30	7.5	1750	11.7

## Recovery Data:



Comments: INSTALLATION OK  
SCREEN WASH (4") TO 155

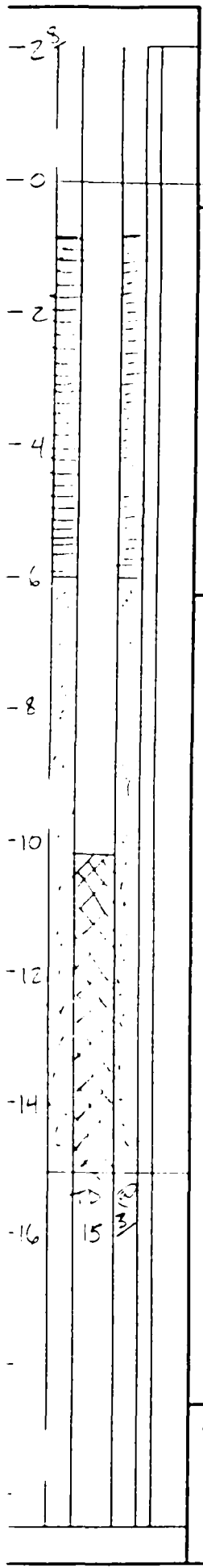
SITE NAME MARCO  
LOCATION CHUNUTE, KANSAS

SUPERVISED BY M. KELLER

DATE \_\_\_\_\_







Well No. P-7  
 Boring No. X-Ref: P-7

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
 Top of Casing \_\_\_\_\_

**Drilling Summary:**

Total Depth 15<sup>3</sup>  
 Borehole Diameter 4" 1/2  
 Casing Stick-up Height: 7'  
 Driller Hydrologic Inc.  
 Rig Small Framehoe DCO  
 Bit(s) 2 1/2" DIA  
 Drilling Fluid \_\_\_\_\_  
 Protective Casing 4" 1/2" STEEL

**Construction Time Log:**

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	12/10	12:00	12/10	12:30
Geophys. Logging				
Casing:				
Filter Placement:				
Cementing:				
Development:				

**Well Design & Specifications**

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
 Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
15' - 15 1/2'	S1	-
10' - 10 1/2'	C1	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
Casing: C1	1" ID PVC	
C2		
Screen: S1	1" ID PVC 10-50"	
S2		
Filter Pack:	10-40 1/2" SAND	
	15' - 6"	
Grout Seal:		
Bentonite Seal:	10-15 1/2" SAND	
	15' - 16"	

**Well Development:**

10-40 1/2" SAND 10-50"  
 SAND PACK 10-50"  
 5' 15" WINDING (3 LATIONS)  
 REMOVED PRIOR TO SAMPLING

**Stabilization Test Data:**

Time	pH	Spec. Cond.	Temp. (C)
153	6.87	1360	50.1
151	6.85	1240	50.5
1500	6.79	1370	50.8

**Recovery Data:**

Q= \_\_\_\_\_ S<sub>0</sub>= \_\_\_\_\_

RECCOVERY (%)

100									
80									
60									
40									
20									
0									

TIME ( )

**Comments:**

MEASUREMENTS GCS

SITE NAME MARCO LOCATION CHUNUTE, KANSAS  
 SUPERVISED BY M. KELLER DATE \_\_\_\_\_

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Well No. P-9  
 Boring No. X-Ref: P-9

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
 \_\_\_\_\_ Top of Casing \_\_\_\_\_

## Drilling Summary:

Total Depth 103  
 Borehole Diameter 4"  
 Casing Stick-up Height: FLUSH MOUNT  
 Driller: HYDROLOGIC INC.  
 Rig: SMITH ELECTRIC 300  
 Bit(s): 4" HSS R-1 13" FLIGHTS  
2.25" DRIVE PANTS  
 Drilling Fluid: \_\_\_\_\_  
 Protective Casing: FLUSH MOUNT

## Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	12/10	8:00	12/10	1:00
Geophys. Logging				
Casing:	12/10	1:00	12/10	1:15
Filter Placement:	12/10	1:15	12/10	1:30
Cementing:	12/10	1:30	12/10	1:45
Development:	12/10	1:45	12/10	1:55

## Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
 Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
103	C	-
53	C	-
-	-	-
-	-	-
-	-	-

Casing: C1 1" ID 11" O.D. 11.5' L  
 C2 \_\_\_\_\_  
 Screen: S1 1" ID 11" O.D. 11.5' L  
 S2 \_\_\_\_\_

Filter Pack: 1" ID 11" O.D. SAND  
103-32  
 Grout Seal: \_\_\_\_\_  
 Bentonite Seal: 1" ID 11" O.D. BENTONITE  
32-12

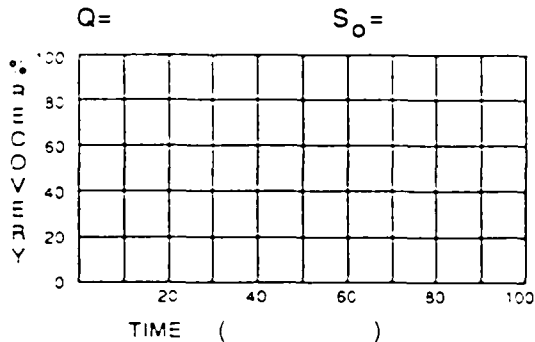
## Well Development:

5 MINUTE WALKERS (2 WALK)  
WAS REMOVED PRIOR TO  
SAMPLING

## Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
1542	7.21	1730	46.9
1545	7.24	1780	47.2
1547	7.23	1800	48.0

## Recovery Data:



Comments: PACK WAS NOT PLACED IN WELL  
REASON: PACK WAS NOT PLACED IN WELL  
REASON: PACK WAS NOT PLACED IN WELL  
REASON: PACK WAS NOT PLACED IN WELL  
REASON: PACK WAS NOT PLACED IN WELL

SITE NAME MARCO

LOCATION CHUTE, KANSAS

SUPERVISED BY M. KELLER

DATE \_\_\_\_\_





Well No. P - 10  
Boring No. X-Ref: P-10

## MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
Top of Casing \_\_\_\_\_

### Drilling Summary:

Total Depth 15.5'  
Borehole Diameter 2.5" NPT  
Casing Stick-up Height: 5' 0" NPT  
Driller Hydrologic Inc.  
Rig SILVER FOX 3000  
Bit(s) 2.5" NPT  
Drilling Fluid ---  
Protective Casing 5' 0" NPT

### Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
<u>4.55</u>	<u>C</u>	<u>---</u>
<u>4.55 - 14.55</u>	<u>S</u>	<u>---</u>
<u>---</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>---</u>	<u>---</u>
<u>---</u>	<u>---</u>	<u>---</u>

Casing: C1 5' 0" NPT  
C2 \_\_\_\_\_  
Screen: S1 14.55 - 15.5'  
S2 \_\_\_\_\_

Filter Pack: 14.55 - 15.5'  
Grout Seal: ---  
Bentonite Seal: 3' - 13'

### Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling				
Geophys. Logging				
Casing:				
Filter Placement:				
Cementing:				
Development:	<u>12/11</u>	<u>850</u>	<u>12/11</u>	<u>0940</u>

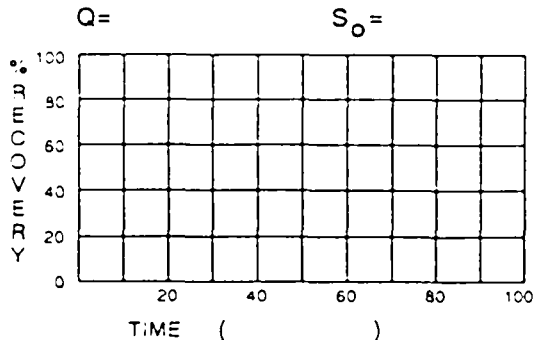
### Well Development:

ACQUA 2.5 GALLONS / 5 CASING Vols  
PRIME TO SAMPLING  
PARAMETERS STABLE

### Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
<u>9:23</u>	<u>6.97</u>	<u>823</u>	<u>57.9</u>
	<u>7.04</u>	<u>815</u>	<u>57.5</u>
	<u>7.27</u>	<u>757</u>	<u>50.9</u>
	<u>7.31</u>	<u>740</u>	<u>49.4</u>
<u>9:39</u>	<u>7.25</u>	<u>748</u>	<u>49.7</u>

### Recovery Data:



Comments: MEASURED 12/15  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SITE NAME MARCO  
LOCATION CHUTE, KANSAS

SUPERVISED BY M. KELLER  
DATE 12/19/97







Well No. P-12  
Boring No. X-Ref: P-12

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
Top of Casing \_\_\_\_\_

## Drilling Summary:

Total Depth 22' 0"  
Borehole Diameter 2.25"  
Casing Stick-up Height: \_\_\_\_\_  
Driller D. DUNN  
HYDROLOGIC INC.  
Rig SIMCO FACTORY 200  
Bit(s) 2.25" DRIVE POINT  
Drilling Fluid \_\_\_\_\_  
Protective Casing FWSH MOUNT

## Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	12/11	1130	12/11	1115
Geophys. Logging				
Casing:		15		1200
Filter Placement:		1205		1220
Cementing: Plug		1220		1245
Development:		1255		1310

## Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
21' 1/2 - 11' 1/2	S1	-
11' 1/2 - 0	C1	-
-	-	-
-	-	-
-	-	-

Casing: C1 1" ID PVC  
C2 \_\_\_\_\_  
Screen: S1 1" ID PVC 10-slot  
S2 \_\_\_\_\_

Filter Pack: 12-40 GRIT SAND

Grout Seal: \_\_\_\_\_

Bentonite Seal: ENVUOPVA MED GRIT  
BENTONITE  
92-10

## Well Development:

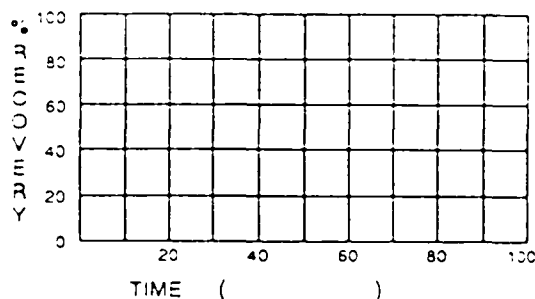
PURGED 41 GALLONS (25 casing vol)  
READY TO SAMPLE

## Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
1259	7.21	2770	50.5
1302	7.13	3430	51.1
1306	7.11	3340	52.1
1310	7.10	3380	52.5

## Recovery Data:

Q = \_\_\_\_\_ S<sub>0</sub> = \_\_\_\_\_



## Comments:

FRAGMENTS RGS

SITE NAME MARCO  
LOCATION CHUTE, KANSAS

SUPERVISED BY M. KELLER

DATE \_\_\_\_\_





Well No. P-14  
Boring No. X-Ref: P-14

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
Top of Casing \_\_\_\_\_

**Drilling Summary:**  
Total Depth 25'  
Borehole Diameter 2.25  
Casing Stick-up Height: Flush  
Driller D. Dubney  
HYDROLOGIC INC.  
Rig SIMCO ENVIROPEAK 700  
Bit(s) 2.25" DRIVE POINT  
Drilling Fluid \_\_\_\_\_  
Protective Casing Flush Mount

		Start		Finish	
		Date	Time	Date	Time
Task					
Drilling		12/12	845	12/12	945
Geophys. Logging					
Casing:			945		950
Filter Placement:			950		1000
Cementing: (ft)			1000		1015
Development:			1020		1035

**Well Design & Specifications**  
Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
Casing String (s): C = Casing S = Screen.

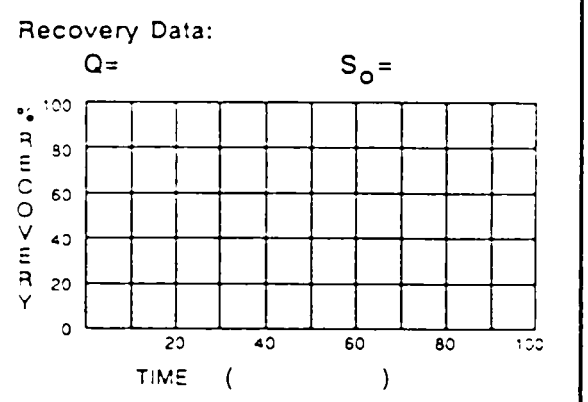
Depth	String(s)	Elevation
24.55 - 14.55	S1	-
4.55 - 0	C1	-
-	-	-
-	-	-
-	-	-

Casing: C1 1" PVC (ID)  
C2 \_\_\_\_\_  
Screen: S1 1" ID PVC 10-5/16"  
S2 \_\_\_\_\_

Filter Pack: 12-40 GRIT SAND  
24.55 - 2  
Grout Seal: \_\_\_\_\_  
Bentonite Seal: 122 - 12  
ENVIRAPUR MEX. GR. BENTONITE

**Well Development:**  
Remarks: 4" (11" GAS / 5 casing lb)  
prior to sampling

Stabilization Test Data:			
Time	pH	Spec. Cond.	Temp (C)
1026	6.56	2790	53.4
	6.56	2660	55.0
	6.62	2650	54.3
	6.60	2660	54.1
1031	6.64	2570	54.4



**Comments:**  
MEASUREMENTS RES

SITE NAME MARCO LOCATION CHUTE, KANSAS  
SUPERVISED BY M. KELLER DATE \_\_\_\_\_



Well No. P - 16  
 Boring No. X-Ref: P - 16

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
 \_\_\_\_\_ Top of Casing \_\_\_\_\_

## Drilling Summary:

Total Depth 22.2  
 Borehole Diameter 2.25"  
 Casing Stick-up Height: FLUSH  
 Driller: HYDROLOGIC INC.  
 Rig SIMCO FACTIMOBILE 200  
 Bit(s) 2.25" DRIVE POINT  
 Drilling Fluid ---  
 Protective Casing FLUSH MOUNT

## Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	12/12	11:50	12/12	1:30
Geophys Logging				
Casing:		12:30		1:30
Filter Placement:		1:30		1:35
Cementing: <u>BA</u>		1:35		2:00
Development:		1:33		1:36

## Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
 Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
21.87 - 11.82	S	-
11.82 - 0	C	-
-	-	-
-	-	-
-	-	-
-	-	-

Casing C1 2" PVC  
 C2 \_\_\_\_\_  
 Screen S1 12-40 GRIT SAND  
 S2 \_\_\_\_\_

Filter Pack: 12-40 GRIT SAND  
21.87 - 12.5  
 Grout Seal: \_\_\_\_\_  
 Bentonite Seal: ENVIRO-PLUG MAX. GRIT  
BENTONITE

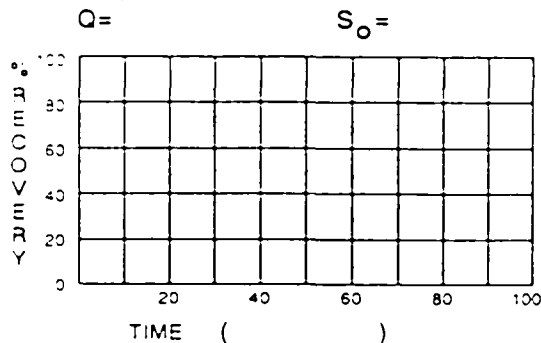
## Well Development:

1.5 min. 4 gal/min 5' down  
then 10 min 10' down

## Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
12:27	7.43	1750	52.7
	7.50	1730	52.0
	7.22	1750	52.0
	7.20	1730	52.1
1:37	7.21	1740	52.0

## Recovery Data:



## Comments:

MEASUREMENTS RGS

SITE NAME MARCO  
 LOCATION CHUTE, KANSAS

SUPERVISED BY M. KELLER

DATE \_\_\_\_\_





Well No. P-13  
Boring No. X-Ref: P-17

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
Top of Casing \_\_\_\_\_

## Drilling Summary:

Total Depth 21.8  
Borehole Diameter 4.00  
Casing Stick-up Height: 2.00  
Driller U.A. Inc.  
HYDROLOGIC INC.  
Rig CO  
Bit(s) 2.25"  
Drilling Fluid \_\_\_\_\_  
Protective Casing \_\_\_\_\_

## Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	12/1	14:20	12/1	17:00
Geophys. Logging				
Casing	12/1	15:00	12/1	15:00
Filter Placement	12/1	15:30	12/1	16:00
Cementing				
Development	12/1	16:15	12/1	16:35

## Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
10' - 10' 68		
10' 68 - 20' 68		

Casing: C1 \_\_\_\_\_  
C2 \_\_\_\_\_  
Screen: S1 \_\_\_\_\_  
S2 \_\_\_\_\_

Filter Pack: 12-40  
20' 68 - 22'  
Grout Seal: \_\_\_\_\_  
Bentonite Seal: 12-40  
20' 68 - 22'

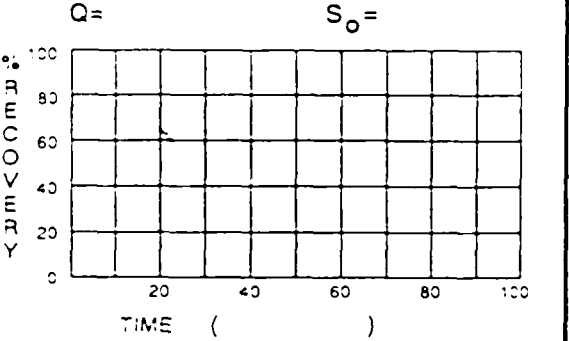
## Well Development:

\_\_\_\_\_

## Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°F)
12/1 14:30	6.90	3350	55.4
12/1 15:00	6.81	3300	55.0
12/1 15:30	6.83	3200	54.3

## Recovery Data:



Comments: \_\_\_\_\_  
MEASURE MENTS R-S

SITE NAME MARCO  
LOCATION CHANNUTE, KANSAS  
SUPERVISED BY M. KELLER  
DATE \_\_\_\_\_





Well No. P-19  
 Boring No. X-Ref: P-19

# MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: \_\_\_\_\_ Elevation Ground Level \_\_\_\_\_  
 Top of Casing \_\_\_\_\_

## Drilling Summary:

Total Depth 212  
 Borehole Diameter 2.25"  
 Casing Stick-up Height: 2.6' (TEMP?)  
 Driller J. SURNEY  
HYDROLOGIC INC.  
 Rig CINCO Earthprobe 700  
 Bit(s) 2.25" DRIVE POINT  
 Drilling Fluid \_\_\_\_\_  
 Protective Casing 1 1/4" S&W

## Well Design & Specifications

Basis: Geologic Log \_\_\_\_\_ Geophysical Log \_\_\_\_\_  
 Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
<u>10<sup>93</sup> - 212</u>	<u>C1</u>	<u>-</u>
<u>20<sup>93</sup> - 10<sup>93</sup></u>	<u>S1</u>	<u>-</u>
<u>-</u>	<u>-</u>	<u>-</u>
<u>-</u>	<u>-</u>	<u>-</u>
<u>-</u>	<u>-</u>	<u>-</u>

Casing: C1 1" ID PVC  
 C2 \_\_\_\_\_  
 Screen: S1 1" ID PVC 10-50T  
 S2 \_\_\_\_\_

Filter Pack: 17-40 GRIT SAND  
20<sup>93</sup> - 90  
 Grout Seal: \_\_\_\_\_  
 Bentonite Seal: ENVICORP 100 AC  
BENTONITE  
22-12

## Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling	<u>12/11</u>	<u>1455</u>	<u>12/11</u>	<u>1540</u>
Geophys. Logging				
Casing:		<u>1540</u>		<u>1550</u>
Filter Placement:		<u>1550</u>		<u>1625</u>
Cementing Plug		<u>1630</u>		<u>1640</u>
Development:		<u>1640</u>		<u>1656</u>

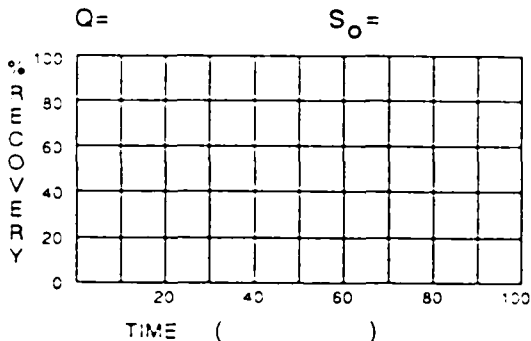
## Well Development:

PURGED APPROX. 7 DISCH. VOLUMES  
5' (2' ON) FROM WELL PRIOR  
TO SAMPLING

## Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
<u>1645</u>	<u>7.80</u>	<u>2040</u>	<u>51.7</u>
	<u>7.73</u>	<u>2060</u>	<u>51.8</u>
	<u>7.44</u>	<u>2060</u>	<u>51.9</u>
	<u>7.40</u>	<u>2040</u>	<u>52.3</u>
<u>1656</u>	<u>7.43</u>	<u>2040</u>	<u>51.9</u>

## Recovery Data:



Comments: MEASUREMENTS RES

SITE NAME MARCO  
 LOCATION CHUTE, KANSAS

SUPERVISED BY M. KELLER

DATE \_\_\_\_\_





**APPENDIX G**

**WELL DEVELOPMENT/PURGE DATA SHEETS**

✓

✓

✓







Well Purging and Recovery  
KDHE/MARCO C.I./KS  
973-2300-4

Sheet 1 of \_\_\_\_\_

Location P-4

Monitored by: M. KELLER Date: 12/13/97 Time: 1130

### Well/Piezometer Data

(circle one)  
Depth of well (from top of PVC or ground) 22.5 feet  
Depth to water (from top of PVC or ground) 4.92 feet  
Radius of casing .5 inches  
Casing Volume 17.9 cubic feet  
0.7 gallons

Temp SW = 11.1'

### Development/Purging Discharge Data

3.7 = 5 casing vol

Purging method VACUUM SYSTEM  
Start Purging Date: 12/13 Time: 1130  
Stop Purging Date: 12/13 Time: 1151

### Monitoring

Date	Time	Volume discharged (gals)	Temp (F)	pH	Spec. Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
12/13	1133	.5	59.8	7.83	1650		VERY CLOUDY / GRAY
		1	59.5	7.50	1660		"
		1.5	59.2	7.78	1650		"
	1137	2	59.4	7.78	1580		"
		2.5	59.6	6.90	1600		NOT CLOUDY " "
		3	59.8	6.80	1620		"
		3.5	59.5	6.22	1620		"
	1141	4	59.2	6.80	1620		"

### Water Level Recovery Data

SAMPLE PH-W-1 @ 1144

Start of recovery Date: \_\_\_\_\_ Time: \_\_\_\_\_

### Monitoring

Date	Clock Time (hh:mm)	Elapsed time (mins)	Water Level (feet) Measurement point: _____

—

—





KDHE / MARCO C.I / KS

973-2300-4

Sheet 1 of 1

### Location

p-6

Monitored by:

M. KELLER

Date:

12/13/97

Time:

2215

### Well/Piezometer Data

(circle one)

Depth of well (from top of PVC or ground)

15 ft

Depth to water (from top of PVC or ground)

13.2 feet

Radius of casing

15 inches

\_\_\_\_\_ feet

## Casing Volume

1.59 cubic feet

0.06	gallons
------	---------

5 vol's = 0.3 gals

### Development/Purging Discharge Data

### Purging method

VACUUM 8-10-64

### Start Purging

Date:

101250

Time:

— 55 —

## Stop Purging

Date:

—

Time:

72

## Monitoring

Date	Time	Volume discharged (gals)	Temp (°F)	pH	Spec.Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
2/13	915	.7	46.9	2.45	830	/	New cloudy - (see v
		.15	49.2	2.54	978	/	" "
	920	.2	48.6	2.61	966	/	" "
		.3	50.2	2.61	1030	/	Water still cloudy
		.5	49.7	2.35	1050	/	" "

Sample PL-W-1 taken @ 930

### Water Level Recovery Data

### Start of recovery

Date:

Time:

## Monitoring

[illegible]

—

—



KDHE / MARCO C.I / KS

Sheet 1 of \_\_\_\_\_

973-2300-4

1-2
-----

M. KELLER

12/10/97

050

(circle one)

152

feet

—

feet

$\therefore f \geq 8$

0.5

inches

feet

△△

cubic feet

1.74

gallons

← REMOVED 2 GALLONS THAT WAS POURED IN  
TO HELP WITH SANDPACK INSULATION (12/50)

## VACUUM SYSTEM

1. / 1.

14-25

---

10 :

1520

Date	Time	Volume discharged (gals)	Temp (°F)	pH	Spec. Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
12/10	1500	INITIAL					
		.5	50.1	7.46	1350		
		1	50.5	7.38	1400		slight yellowish tint
	1510	1.5	50.3	7.36	1310		
	1513	2	50.1	7.37	1360		
	1517	2.5	50.5	7.25	1340		
	1520	3.0	50.1	7.2	1350		

Sample 1000 19/10 P7-11-1

Date:

Time:

[illegible]





**Golder  
Associates**

**Well Purging and Recovery**  
KDHE / MARCO C.I. / KS  
973-2300-4

Sheet 1 of \_\_\_\_

Location

P-9

Monitored by:

M. KELLER

Date:

12/15/97

Time:

1500

**Well/Piezometer Data**

Depth of well (from top of PVC or ground)

(circle one)

10.3 feet

Depth to water (from top of PVC or ground)

1.4 feet

Radius of casing

.5 inches  
feet

Casing Volume

.16 cubic feet  
.38 gallons

**Development/Purging Discharge Data**

Purging method

VACUUM SYSTEM

Start Purging

Date:

12/15

Time:

1500

Stop Purging

Date:

12/15

Time:

1555

**Monitoring**

Date	Time	Volume discharged (gals)	Temp (°F)	pH	Spec. Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
12/15	1500	.6	73.3	7.6	1200	1	clear
12/15	1505	1	73.4	7.7	1200	1	clear
12/15	1515	1.5	73.2	7.7	1180	1	clear
12/15	1547	2	73.0	7.8	1240	1	clear

**Water Level Recovery Data**

Start of recovery

Date:

12/15

Time:

1550

Monitoring

Date	Clock Time (hh:mm)	Elapsed time (mins)	Water Level (feet) Measurement point

WELL SAMPLES 1550 (P9-W-1)





KDHE / MARCO C.I / KS

973-2300.4

Sheet 1 of \_\_\_\_\_

P-10

Ash Grove property

M. KELLER

12/11/97

250

Depth of well (from top of PVC <sup>(circle one)</sup> or ground)

15.65 feet

$$T_{\text{exp}} \text{ s/lj} = 1.1$$

Depth to water (from top of PVC or ground)

2 1/4 feet

1.5 inches

\_\_\_\_\_ feet

1251 cubic feet

0.51 gallons

## VACUUM SYSTEM

12/11

0914

12/1

0939

[illegible]

SCREENING sample PID-W-1 TAKEN @ 0542

Date:

Time:

[illegible]







KDHE / MARCO C.I / KS

Sheet 1 of

$$973 \cdot 2300 \cdot 4$$

P-12

M. KELLER

12/1/97

1745

Temp 5/10 .66

(circle one)

21.  $\frac{16}{1}$

22<sup>00</sup> feet

212 sec

15 inches

feet

20.49 cubic feet

84	gallons
----	---------

## VACUUM SYSTEM

## VACUUM SYSTEM

Date:

12/11

Time:

1255

Date:

12	14
----	----

Time:

1310

Date	Time	Volume discharged (gals)	Temp (°F)	pH	Spec. Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
12/11	1257	1.15 mL	51.6	7.30	2820		Very cloudy - grey
		1	50.5	7.21	2770		"
	1302	2	51.1	7.13	3430		"
		3	52.1	7.11	3340		Increasingly cloudy - grey
	1310	4	52.5	7.10	3220		

sample → PIC-W-1 @ 13/0

### Start of recovery

Date:

Time:

## Monitoring

[illegible]

—

—



KDHE / MARCO C.I / KS

973-2300.4

P-14 GERKE SOAP VED

M. KELLER

12/12/97

1070

(circle one)

250

45

5

feet

20.0

82

gallons

## VACUUM SYSTEM

$$12 \overline{) 12}$$

1020

12 11 2

1031

Date	Time	Volume discharged (gals)	Temp (°F)	pH	Spec. Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
12/12	1023	.5	45.9	6.33	2070		very cloudy - brown
		1	52.8	6.45	2250		"
	1026	1.5	53.4	6.50	2290		"
		2	55.0	6.56	2660		"
	1028	3	54.3	6.62	2650		More water by
		3.5	54.4	6.60	2660		"
	1031	4	54.4	6.64	2670		"

Sample well P14-W-1 & P14-W-1D @ 1035

## Time:

[illegible]













### Location

f-9

Monitored by:

M. KELLER

Date:

12/11/97

Time:

1635

### Well/Piezometer Data

Depth of well (from top of PVC or ground)

70.93

7 feet

Depth to water (from top of PVC or ground)

2.

7 feet

Radius of casing

1.5

Inches

feet

## Casing Volume

14.33

cubic feet

2.59

gallons

### Development/Purging Discharge Data

### Purging method

## VACUUM SYSTEM

## Start Pumping

Date: \_\_\_\_\_

12/11/95

Time:

1640

## Stop Purging

Date:

12 / 11

Time:

1656

### Monitoring

Date	Time	Volume discharged (gals)	Temp (°F)	pH	Spec. Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
12/11							VERY CLOUDY - BROWN
	1645	.5	51.7	7.80	2040		"
		2	51.8	7.73	2060		"
		2.5	51.9	7.44	2070		"
		3.5	52.3	7.40	2040		Mud.
	1656	4	51.9	7.43	2040		"

## Water Level Recovery Data

### Start of recovery

Date:

Time:

## Monitoring

[illegible]





KDHE / MARCO C.I / KS

$$973 \cdot 2300 \cdot 4$$

Sheet 1 of \_\_\_\_\_

MI

M. KELLER

12/13/97

133

Stick up 1.71

26.71 feet

4.96 feet

1 inches

feet

21.75 cubic feet

348	gallons
-----	---------

10.4 gallon purge

## ELECTRIC PUMP

### ELECTRIC PUMP

12 / 13

1933

12/13

Time:

Date	Time	Volume discharged (gals)	Temp (°F)	pH	Spec. Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
12/13	1933	2	46.5	7.10	1620		Slightly cloudy
		4	51.7	6.92	1690		"
		6	72.2	7.18	1720		"
		8	43.5	7.08	1720		"
	2010	10	42.9	7.12	1710		"

Well sampled 2015 12/13/97

Date:

Time:

[illegible]





KDHE/MARCO C.I/KS

Sheet 1 of 1

973.2300.4

M3

M. KELLER

Date:

12/13/97

Time:

Strike up 31"

(circle one)

79.58

7 feet

913.67

212

feet:

1

Inches

feet

26.54

cubic feet

4.2

gallons

12.7 gallons freeze

4. AC 7510

1324

Date:

17 42

Time:

1755

Date:

1

Time:

1855

[illegible]

Well Sampled 1900

Date:

Time:

[illegible]





KDHE/MARCO C.I./KS

Sheet 1 of

973.2300.4

1-4

M. KELLER

12/13/97

Time:

11 2nd 10 11

(circle one)

17.0 feet

4.75 feet

936.64 E'KV.

1	inches
	feet

12.75	cubic feet
1.96	gallons

5.9 gallon TOTAL FUEL

ELECTRIC PUMP

Date: \_\_\_\_\_

$$\boxed{12 \mid 13}$$

Time:

Date:

343

Time:

[illegible]

WELL Sampled 1745

Date:

Time:

[illegible]





**APPENDIX H**

**HLI ANALYTICAL RESULTS**





1927 N. 1275 Road Eudora, Kansas 66025-8127

Office (913) 542-2518

Fax (913) 542-3971

December 19, 1997

**RECEIVED**

**DEC 26 1997**

Golder Associates, Inc.  
Attn: Mike Keller  
200 Union Blvd.  
Suite 500  
Lakewood, CO 80228

**GOLDER ASSOCIATES**

97-66-118

RE: Final Analytical Report for the Former MARCO Refinery in Chanute, Kansas.

Mr. Keller,

Hydro-LOGIC, Inc. (HLI) is pleased to submit the analytical results for the above referenced site. A total of 19 soil samples and 23 groundwater samples were analyzed for purgeable chlorinated hydrocarbons and aromatic hydrocarbons, by USEPA method 8021, and for total petroleum hydrocarbons, by method OA-2. Additionally four (4) duplicates and two (2) drum water samples were also analyzed. Analytical results for all samples follow on the enclosed laboratory data sheets.

HLI appreciates this opportunity to provide our environmental services. Should you have any questions or require additional information, please call myself or Don Dulaney at (785) 542-2518.

Sincerely,  
Hydro-LOGIC, Inc.

Peter Guy  
Environmental Scientist/Chemist

Attachments



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P10-S-1 7.5'  
 Date Sampled: 12/9/97  
 Date Analyzed: 12/9/97

Sample: 1 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDROLOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P10-S-1 7.5'  
Date Sampled: 12/9/97  
Date Analyzed: 12/9/97

Sample: 1 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed Peter Guy  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P18-S-1 3.0'  
 Date Sampled: 12/9/97  
 Date Analyzed: 12/9/97

Sample: 2 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P18-S-1 3.0'  
Date Sampled: 12/9/97  
Date Analyzed: 12/9/97

Sample: 2 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed Peter Guy  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P18  
 Date Sampled: 12/9/97  
 Date Analyzed: 12/9/97

Sample: 3 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P18  
Date Sampled: 12/9/97  
Date Analyzed: 12/9/97

Sample: 3 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

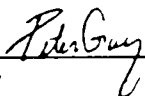
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst







# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P9-S-1 1.5'  
 Date Sampled: 12/10/97  
 Date Analyzed: 12/10/97

Sample: 4 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P9-S-1 1.5'  
Date Sampled: 12/10/97  
Date Analyzed: 12/10/97

Sample: 4 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst

1

2

# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P8-S-1 2.0'  
 Date Sampled: 12/10/97  
 Date Analyzed: 12/10/97

Sample: 5 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDRO-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P8-S-1 2.0'  
Date Sampled: 12/10/97  
Date Analyzed: 12/10/97

Sample: 5 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

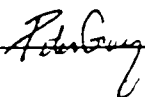
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst







# ANALYTICAL REPORT

Client/Site: Colder Assoc./MARCO Refinery  
 Sample ID: P8  
 Date Sampled: 12/10/97  
 Date Analyzed: 12/10/97

Sample: 6 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-L O G I C



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P8  
Date Sampled: 12/10/97  
Date Analyzed: 12/10/97

Sample: 6 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-


### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



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# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P7-S-1 1.5'  
 Date Sampled: 12/10/97  
 Date Analyzed: 12/10/97

Sample: 7 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	6.70	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg      Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC

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## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P7-S-1 1.5'  
Date Sampled: 12/10/97  
Date Analyzed: 12/10/97

Sample: 7 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	2.63	1.00 mg/kg <sup>2</sup>	-

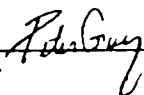
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst







# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P7  
 Date Sampled: 12/10/97  
 Date Analyzed: 12/10/97

Sample: 8 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	3.20	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-10-10



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P7  
Date Sampled: 12/10/97  
Date Analyzed: 12/10/97

Sample: 8 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_

Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P9  
 Date Sampled: 12/10/97  
 Date Analyzed: 12/10/97

Sample: 9 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	1.20	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-L O G I C



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P9  
Date Sampled: 12/10/97  
Date Analyzed: 12/10/97

Sample: 9 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed Peter Guy  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P11-S-1  
 Date Sampled: 12/10/97  
 Date Analyzed: 12/10/97

Sample: 10 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-L D G I C



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P11-S-1  
Date Sampled: 12/10/97  
Date Analyzed: 12/10/97

Sample: 10 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

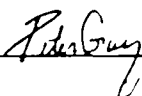
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** P11  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 11 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HydroQual LLC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P11

Date Sampled: 12/11/97

Date Analyzed: 12/11/97

Sample: 11 of 48

Method: EPA 8021/OA-2

Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	0.566	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/l Micrograms per liter (parts per billion).

<sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_

Peter T. Guy

Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** P10  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 12 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P10

Date Sampled: 12/11/97

Date Analyzed: 12/11/97

Sample: 12 of 48

Method: EPA 8021/OA-2

Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/l Micrograms per liter (parts per billion).

<sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P12-S-1  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 13 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P12-S-1  
Date Sampled: 12/11/97  
Date Analyzed: 12/11/97

Sample: 13 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P12  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 14 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	4.00	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P12  
Date Sampled: 12/11/97  
Date Analyzed: 12/11/97

Sample: 14 of 48  
Method: EPA 8021/CA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed Peter T. Guy  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** P17  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 15 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l      Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P17  
Date Sampled: 12/11/97  
Date Analyzed: 12/11/97

Sample: 15 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed Peter T. Guy  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P19  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 16 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P19-S-1 3.5'  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 17 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P19-S-1 3.5'  
Date Sampled: 12/11/97  
Date Analyzed: 12/11/97

Sample: 17 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	4.67	1.00 mg/kg <sup>2</sup>	-

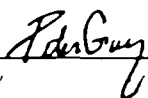
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P17-S-1  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 18 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P17-S-1

Date Sampled: 12/11/97

Date Analyzed: 12/11/97

Sample: 18 of 48

Method: EPA 8021/OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P14  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 19 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,1,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P14  
Date Sampled: 12/12/97  
Date Analyzed: 12/12/97

Sample: 19 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

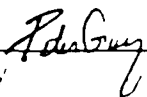
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P16  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 20 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P16

Date Sampled: 12/12/97

Date Analyzed: 12/12/97

Sample: 20 of 48

Method: EPA 8021/OA-2

Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/l Micrograms per liter (parts per billion).

<sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P16-S-1 3.0'  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 21 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P16-S-1 3.0'

Date Sampled: 12/12/97

Date Analyzed: 12/12/97

Sample: 21 of 48

Method: EPA 8021/OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Colder Assoc./MARCO Refinery  
 Sample ID: P2-S-1 3.5'  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 22 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P2-S-1 3.5'

Date Sampled: 12/12/97

Date Analyzed: 12/12/97

Sample: 22 of 48

Method: EPA 8021/OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	17.9	10.0 µg/kg	-
Ethylbenzene	40.2	10.0 µg/kg	-
Xylenes (o,m,p)	44.2	30.0 µg/kg	1
Naphthalene	495	10.0 µg/kg	-
TPH (DRO)	45.9	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** P1  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 23 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-L D G I C



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P1  
Date Sampled: 12/12/97  
Date Analyzed: 12/12/97

Sample: 23 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

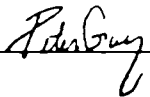
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P2  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 24 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	485	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l      Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDRO-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P2

Date Sampled: 12/12/97

Date Analyzed: 12/12/97

Sample: 24 of 48

Method: EPA 8021/OA-2

Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	16.8	2.00 µg/l	-
Toluene	9.08	2.00 µg/l	-
Ethylbenzene	7.24	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	18.9	2.00 µg/l	-
TPH (DRO)	0.552	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P14-S-1  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 25 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-L-610



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P14-S-1

Date Sampled: 12/12/97

Date Analyzed: 12/12/97

Sample: 25 of 48

Method: EPA 8021/OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P6-S-1 2,3'  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 26 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P6-S-1 2.3'  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 26 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P6  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 27 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOG-10



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P6  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 27 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P4-S-1 3.8'  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 28 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 20.0	20.0 µg/kg
Chloromethane	< 20.0	20.0 µg/kg
Vinyl chloride	< 20.0	20.0 µg/kg
Bromomethane	< 20.0	20.0 µg/kg
Chloroethane	< 20.0	20.0 µg/kg
Trichlorofluoromethane	< 20.0	20.0 µg/kg
1,1-Dichloroethene	< 20.0	20.0 µg/kg
Methylene chloride	< 20.0	20.0 µg/kg
trans-1,2-Dichloroethene	< 20.0	20.0 µg/kg
1,1-Dichloroethane	< 20.0	20.0 µg/kg
Chloroform	< 20.0	20.0 µg/kg
1,1,1-Trichloroethane	< 20.0	20.0 µg/kg
Carbon tetrachloride	< 20.0	20.0 µg/kg
1,2-Dichloroethane	< 20.0	20.0 µg/kg
Trichloroethene (TCE)	< 20.0	20.0 µg/kg
1,2-Dichloropropane	< 20.0	20.0 µg/kg
Bromodichloromethane	< 20.0	20.0 µg/kg
cis-1,3-Dichloropropene	< 20.0	20.0 µg/kg
trans-1,3-Dichloropropene	< 20.0	20.0 µg/kg
1,1,2-Trichloroethane	< 20.0	20.0 µg/kg
Tetrachloroethene (PCE)	< 20.0	20.0 µg/kg
Dibromochloromethane	< 20.0	20.0 µg/kg
Chlorobenzene	< 20.0	20.0 µg/kg
Bromoform	< 20.0	20.0 µg/kg
1,1,2,2-Tetrachloroethane	< 20.0	20.0 µg/kg
1,3-Dichlorobenzene	< 20.0	20.0 µg/kg
1,4-Dichlorobenzene	< 20.0	20.0 µg/kg
1,2-Dichlorobenzene	< 20.0	20.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDROLOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P4-S-1 3.8'  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 28 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 40.0	40.0 µg/kg <sup>1</sup>	-
Benzene	624	40.0 µg/kg	-
Toluene	1340	40.0 µg/kg	-
Ethylbenzene	673	40.0 µg/kg	-
Xylenes (o,m,p)	1350	120 µg/kg	1
Naphthalene	6170	10.0 µg/kg	-
TPH (DRO)	163	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P4  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 29 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 2.0	2.0 µg/l
Chloromethane	< 2.0	2.0 µg/l
Vinyl chloride	< 2.0	2.0 µg/l
Bromomethane	< 2.0	2.0 µg/l
Chloroethane	< 2.0	2.0 µg/l
Trichlorofluoromethane	< 2.0	2.0 µg/l
1,1-Dichloroethene	< 2.0	2.0 µg/l
Methylene chloride	< 2.0	2.0 µg/l
trans-1,2-Dichloroethene	< 2.0	2.0 µg/l
1,1-Dichloroethane	< 2.0	2.0 µg/l
Chloroform	< 2.0	2.0 µg/l
1,1,1-Trichloroethane	< 2.0	2.0 µg/l
Carbon tetrachloride	< 2.0	2.0 µg/l
1,2-Dichloroethane	< 2.0	2.0 µg/l
Trichloroethene (TCE)	< 2.0	2.0 µg/l
1,2-Dichloropropane	< 2.0	2.0 µg/l
Bromodichloromethane	< 2.0	2.0 µg/l
cis-1,3-Dichloropropene	< 2.0	2.0 µg/l
trans-1,3-Dichloropropene	< 2.0	2.0 µg/l
1,1,2-Trichloroethane	< 2.0	2.0 µg/l
Tetrachloroethene (PCE)	< 2.0	2.0 µg/l
Dibromochloromethane	< 2.0	2.0 µg/l
Chlorobenzene	< 2.0	2.0 µg/l
Bromotorm	< 2.0	2.0 µg/l
1,1,2,2-Tetrachloroethane	< 2.0	2.0 µg/l
1,3-Dichlorobenzene	< 2.0	2.0 µg/l
1,4-Dichlorobenzene	< 2.0	2.0 µg/l
1,2-Dichlorobenzene	< 2.0	2.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P4  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 29 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 4.00	4.00 µg/l <sup>1</sup>	-
Benzene	645	4.00 µg/l	-
Toluene	367	4.00 µg/l	-
Ethylbenzene	148	4.00 µg/l	-
Xylenes (o,m,p)	150	12.0 µg/l	1
Naphthalene	202	4.00 µg/l	-
TPH (DRO)	1.73	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P5  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 30 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,1,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-100-000





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P5

Date Sampled: 12/13/97

Date Analyzed: 12/13/97

Sample: 30 of 48

Method: EPA 8021/OA-2

Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	12.0	2.00 µg/l	-
Toluene	15.1	2.00 µg/l	-
Ethylbenzene	2.18	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/l Micrograms per liter (parts per billion).

<sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P5-S-1 10.9'  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 33 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

ANALYTICAL REPORT



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P5-S-1 10.9'  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 31 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

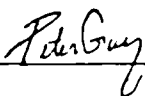
### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst





# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P3  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 32 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P3  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 32 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed Peter T. Guy  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** P3-S-1  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 33 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg      Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDROLOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P3-S-1

Date Sampled: 12/13/97

Date Analyzed: 12/13/97

Sample: 33 of 48

Method: EPA 8021/OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	1.41	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P15  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 34 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDROLOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P15  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 34 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed Peter T. Guy  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** M4  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 35 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l      Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: M4  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 35 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT


Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: M1  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 36 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed   
 Analyst - Peter Guy

HYDROLOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: M1

Date Sampled: 12/13/97

Date Analyzed: 12/13/97

Sample: 36 of 48

Method: EPA 8021/OA-2

Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	372	2.00 µg/l	-
Toluene	19.6	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/l Micrograms per liter (parts per billion).

<sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** P13  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 37 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P13  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 37 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P13-S-1  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/14/97

Sample: 38 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromoform	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P13-S-1

Date Sampled: 12/13/97

Date Analyzed: 12/14/97

Sample: 38 of 48

Method: EPA 8021/OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P20  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/14/97

Sample: 39 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDRO-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P20  
Date Sampled: 12/13/97  
Date Analyzed: 12/14/97

Sample: 39 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	1.68	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P20-S-1  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/14/97

Sample: 40 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P20-S-1  
Date Sampled: 12/13/97  
Date Analyzed: 12/14/97

Sample: 40 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	243	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** P15-S-1  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/14/97

Sample: 41 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDROLOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P15-S-1

Date Sampled: 12/13/97

Date Analyzed: 12/14/97

Sample: 41 of 48

Method: EPA 8021/OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_

Peter T. Guy

Analyst



# ANALYTICAL REPORT

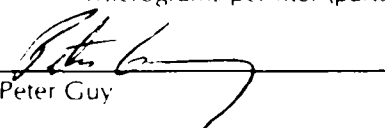
Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: M3  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/14/97

Sample: 42 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromoform	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed   
 Analyst - Peter Guy

HYDROLOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: M3

Date Sampled: 12/13/97

Date Analyzed: 12/14/97

Sample: 42 of 48

Method: EPA 8021/OA-2

Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

<sup>1</sup> µg/l Micrograms per liter (parts per billion).

<sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed

Peter T. Guy

Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: **Barrel 1**  
 Date Sampled: 12/11/97  
 Date Analyzed: 12/11/97

Sample: 43 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	17.4	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: Barrel 1  
Date Sampled: 12/11/97  
Date Analyzed: 12/11/97

Sample: 43 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID:** **Barrel 2**  
 Date Sampled: 12/12/97  
 Date Analyzed: 12/12/97

Sample: 44 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	8.65	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l      Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydri-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: Barrel 2  
Date Sampled: 12/12/97  
Date Analyzed: 12/12/97

Sample: 44 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	6.40	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).
- <sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
**Sample ID: P18 duplicate**  
 Date Sampled: 12/9/97  
 Date Analyzed: 12/9/97

Sample: 45 of 48  
 Method: EPA 8021  
 Matrix: Water

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 1.0	1.0 µg/l
Chloromethane	< 1.0	1.0 µg/l
Vinyl chloride	< 1.0	1.0 µg/l
Bromomethane	< 1.0	1.0 µg/l
Chloroethane	< 1.0	1.0 µg/l
Trichlorofluoromethane	< 1.0	1.0 µg/l
1,1-Dichloroethene	< 1.0	1.0 µg/l
Methylene chloride	< 1.0	1.0 µg/l
trans-1,2-Dichloroethene	< 1.0	1.0 µg/l
1,1-Dichloroethane	< 1.0	1.0 µg/l
Chloroform	< 1.0	1.0 µg/l
1,1,1-Trichloroethane	< 1.0	1.0 µg/l
Carbon tetrachloride	< 1.0	1.0 µg/l
1,2-Dichloroethane	< 1.0	1.0 µg/l
Trichloroethene (TCE)	< 1.0	1.0 µg/l
1,2-Dichloropropane	< 1.0	1.0 µg/l
Bromodichloromethane	< 1.0	1.0 µg/l
cis-1,3-Dichloropropene	< 1.0	1.0 µg/l
trans-1,3-Dichloropropene	< 1.0	1.0 µg/l
1,1,2-Trichloroethane	< 1.0	1.0 µg/l
Tetrachloroethene (PCE)	< 1.0	1.0 µg/l
Dibromochloromethane	< 1.0	1.0 µg/l
Chlorobenzene	< 1.0	1.0 µg/l
Bromotorm	< 1.0	1.0 µg/l
1,1,2,2-Tetrachloroethane	< 1.0	1.0 µg/l
1,3-Dichlorobenzene	< 1.0	1.0 µg/l
1,4-Dichlorobenzene	< 1.0	1.0 µg/l
1,2-Dichlorobenzene	< 1.0	1.0 µg/l

Units:

1. µg/l Micrograms per liter (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

Hydro-LOGIC



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P18 duplicate  
Date Sampled: 12/9/97  
Date Analyzed: 12/9/97

Sample: 45 of 48  
Method: EPA 8021/OA-2  
Matrix: Water

Analyte	Concentration	Detection Limit	Flag
MtBE	< 2.00	2.00 µg/l <sup>1</sup>	-
Benzene	< 2.00	2.00 µg/l	-
Toluene	< 2.00	2.00 µg/l	-
Ethylbenzene	< 2.00	2.00 µg/l	-
Xylenes (o,m,p)	< 6.00	6.00 µg/l	1
Naphthalene	< 2.00	2.00 µg/l	-
TPH (DRO)	< 0.50	0.50 mg/l <sup>2</sup>	2

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.
2. Parameter not measured in this sample.

### Unit Conversions:

- <sup>1</sup> µg/l Micrograms per liter (parts per billion).  
<sup>2</sup> mg/l Milligrams per liter (parts per million).

Signed Peter T. Guy  
Peter T. Guy  
Analyst



# ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
 Sample ID: P6-S-1 duplicate  
 Date Sampled: 12/13/97  
 Date Analyzed: 12/13/97

Sample: 46 of 48  
 Method: EPA 8021  
 Matrix: Soil

Analyte	Concentration	Detection Limit
Dichlorodifluoromethane	< 5.0	5.0 µg/kg
Chloromethane	< 5.0	5.0 µg/kg
Vinyl chloride	< 5.0	5.0 µg/kg
Bromomethane	< 5.0	5.0 µg/kg
Chloroethane	< 5.0	5.0 µg/kg
Trichlorofluoromethane	< 5.0	5.0 µg/kg
1,1-Dichloroethene	< 5.0	5.0 µg/kg
Methylene chloride	< 5.0	5.0 µg/kg
trans-1,2-Dichloroethene	< 5.0	5.0 µg/kg
1,1-Dichloroethane	< 5.0	5.0 µg/kg
Chloroform	< 5.0	5.0 µg/kg
1,1,1-Trichloroethane	< 5.0	5.0 µg/kg
Carbon tetrachloride	< 5.0	5.0 µg/kg
1,2-Dichloroethane	< 5.0	5.0 µg/kg
Trichloroethene (TCE)	< 5.0	5.0 µg/kg
1,2-Dichloropropane	< 5.0	5.0 µg/kg
Bromodichloromethane	< 5.0	5.0 µg/kg
cis-1,3-Dichloropropene	< 5.0	5.0 µg/kg
trans-1,3-Dichloropropene	< 5.0	5.0 µg/kg
1,1,2-Trichloroethane	< 5.0	5.0 µg/kg
Tetrachloroethene (PCE)	< 5.0	5.0 µg/kg
Dibromochloromethane	< 5.0	5.0 µg/kg
Chlorobenzene	< 5.0	5.0 µg/kg
Bromotorm	< 5.0	5.0 µg/kg
1,1,2,2-Tetrachloroethane	< 5.0	5.0 µg/kg
1,3-Dichlorobenzene	< 5.0	5.0 µg/kg
1,4-Dichlorobenzene	< 5.0	5.0 µg/kg
1,2-Dichlorobenzene	< 5.0	5.0 µg/kg

Units:

1. µg/kg Micrograms per kilogram (parts per billion).

Signed Peter Guy  
 Analyst - Peter Guy

HYDRO-LOGIC





## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P6-S-1 duplicate  
Date Sampled: 12/13/97  
Date Analyzed: 12/13/97

Sample: 46 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	-
Benzene	< 10.0	10.0 µg/kg	-
Toluene	< 10.0	10.0 µg/kg	-
Ethylbenzene	< 10.0	10.0 µg/kg	-
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1
Naphthalene	< 10.0	10.0 µg/kg	-
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	2

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.
2. Parameter not measured in this sample.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed \_\_\_\_\_  
Peter T. Guy  
Analyst



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery

Sample ID: P15-S-1 duplicate

Date Sampled: 12/13/97

Date Analyzed: 12/14/97

Sample: 47 of 48

Method: EPA 8021 OA-2

Matrix: Soil

Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	2
Benzene	< 10.0	10.0 µg/kg	2
Toluene	< 10.0	10.0 µg/kg	2
Ethylbenzene	< 10.0	10.0 µg/kg	2
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1,2
Naphthalene	< 10.0	10.0 µg/kg	2
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-


### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.
2. Parameter not measured in this sample.

### Unit Conversions:

<sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).

<sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed   
Peter T. Guy  
Analyst



## ANALYTICAL REPORT

Client/Site: Golder Assoc./MARCO Refinery  
Sample ID: P5-S-1 duplicate  
Date Sampled: 12/13/97  
Date Analyzed: 12/14/97

Sample: 48 of 48  
Method: EPA 8021/OA-2  
Matrix: Soil

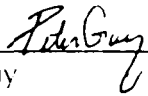
Analyte	Concentration	Detection Limit	Flag
MtBE	< 10.0	10.0 µg/kg <sup>1</sup>	2
Benzene	< 10.0	10.0 µg/kg	2
Toluene	< 10.0	10.0 µg/kg	2
Ethylbenzene	< 10.0	10.0 µg/kg	2
Xylenes (o,m,p)	< 30.0	30.0 µg/kg	1,2
Naphthalene	< 10.0	10.0 µg/kg	2
TPH (DRO)	< 1.00	1.00 mg/kg <sup>2</sup>	-

### Key to Flags

1. Detection limit is for the sum of the three (3) xylenes.
2. Parameter not measured in this sample.

### Unit Conversions:

- <sup>1</sup> µg/kg Micrograms per kilogram (parts per billion).
- <sup>2</sup> mg/kg Milligrams per kilogram (parts per million).

Signed   
Peter T. Guy  
Analyst





1927 N. 1275 Road Eudora, Kansas 66025-8127

Office (785) 542-2518

Fax (785) 542-3971

Page 1 of 3Project Name: MARCO RefineryProject Number: 97-66-118Project Site: Chanute KSContact Person: MikeNo.  
of  
ContainersAnalyses Requested  
8021  
6A-2

Sample ID	Date	Time	Matrix (S/W/A)	No. of Containers						Notes:
1 P10-S-1 7.5'	12-9-97		S	1	X	X				
2 P18-S-1 3.0'			S	1	X	X				
3 P-18-W-1		16:40	W	1	X	X				
4 P-9-S-1 1.5'	12-10-97	8:37	S	1	X	X				
5 P8-S-1 2.0'		9:55	S	1	X	X				
6 P8-W-1		10:31	W	1	X	X				
7 P7-S-1 1.5'		11:17	S	1	X	X				
8 P-7		3:20	W	2	X	X				
9 P-9		3:45	W	2	X	X				
10 P11-S-1		16:40	S	1	X	X				
11 P11	12-11-97	9:00	W	2	X	X				
12 P10		9:30	W	2	X	X				
13 P12-S-1		1445	S	1	X	X				
14 P2		1445	W	2	X	X				
15										
16										

Relinquished by:	Date:	Time:	Received by:
			<u>[Signature]</u>







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Page 2 of 3

Project Name: Marco Refinery  
 Project Number: 97-66-118  
 Project Site: Chanute, KS  
 Contact Person: Mike

Sample ID	Date	Time	Matrix (S/W/A)	No. of Containers	Analyses Requested				Notes:
					8021	01-2			
1	P17	12-14-97	1730	W	2	X	X		
2	P19		1730	W	2	X	X		
3	P19-S-1 3.5'		1730	S	1	X	X		
4	P17-S-1		1730	S	1	X	X		
5	P14	12-12-97	1040	W	2	X	X		
6	P16		1400	W	2	X	X		
7	P16-S-1 3'		1400	S	1	X	X		
8	P3-S-1 3.5'		1700	S	1	X	X		
9	P1		1800	W	1	X	X		
10	P2		1830	W	2	X	X		
11	P14-S-1		1030	S	1	X	X		
12	P6-S-1 2.3'	12-13-97	0840	S	1	X	X		
13	P6		0900	W	2	X	X		
14	P4-S-1 3.9'		1010	S	1	X	X		
15	P4		1200	W	2	X	X		
16	P5		1300	EW	2	X	X		

Relinquished by:	Date:	Time:	Received by:
			<i>[Signature]</i>





1927 N. 1275 Road Eudora, Kansas 66025-8127

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Fax (785) 542-3971

Page 3 of 33Project Name: Marsa RefineryProject Number: 97-66-118Project Site: Cherokee, KSContact Person: Mike

Sample ID	Date	Time	Matrix (S/W/A)	No. of Containers	Analyses Requested				Notes:
					SO <sub>2</sub>	CA-2			
1	P5-S-1 10.9'	12-13-97	1250	S	1	X	X		
2	P3	12-13-97	1410	W	2	X	X		
3	P3-S-1	12-13-97	1545	S	1	X	X		
4	P15	12-13-97	1600	W	2	X	X		
5	M-41		1800	W	2	X	X		
6	M-3			W	2	X	X		
7	P13			W	2	X	X		
8	P13 S1			S	1	X	X		
9	P20			W	2	X	X		
10	P20 S-1			S	1	X	X		
11	P15-S-1			S	1	X	X		
12	M-1			W	2	X	X		
13									
14									
15									
16									

Relinquished by:	Date:	Time:	Received by:
			<i>[Signature]</i>



**APPENDIX I**  
**PACE ANALYTICAL RESULTS**



# Pace Analytical

Pace Analytical Services, Inc  
9608 Loiret Blvd  
Lenexa, KS 66219  
Tel: 913-599-5665  
Fax: 913-599-1759

RECEIVED

JAN - 2 1998

GOLDER ASSOCIATES

December 29, 1997

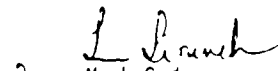
Mr. RANDY MARCH  
GOLDER ASSOCIATES INC  
200 UNION BOULEVARD  
SUITE 500  
LAKEWOOD, CO 80228

RE: Pace Project Number: 6019010  
Client Project ID: Marco, KS

Dear Mr. MARCH:

Enclosed are the results of analyses for sample(s) received on December 14, 1997. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

  
Mark Gudnason  
Project Manager

Enclosures

## REPORT OF LABORATORY ANALYSIS

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# Pace Analytical

Pace Analytical Services, Inc  
9608 Loiret Blvd  
Lenexa, KS 66219

Tel 913-599-5665

Fax 913-599-1759

DATE: 12/29/97

PAGE: 1

GOLDER ASSOCIATES INC  
200 UNION BOULEVARD  
SUITE 500  
LAKEWOOD, CO 80228

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Attn: Mr. RANDY MARCH  
Phone: (303)980-0540

Solid results are reported on a wet weight basis

Pace Sample No:	601638414	Date Collected:	12/10/97	Matrix:	Soil
Client Sample ID:	P18-S-10	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
------------	---------	-------	-----	----------	---------	------	-----------

GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: 5030 Med Lvl Soil
Chloromethane	400 ug/kg	20 12/24/97 MJW 74-87-3 1
Vinyl Chloride	ND ug/kg	45 12/24/97 MJW 75-01-4
Bromomethane	ND ug/kg	75 12/24/97 MJW 74-83-9
Chloroethane	ND ug/kg	130 12/24/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/kg	120 12/24/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/kg	34 12/24/97 MJW 75-35-4
Methylene Chloride	ND ug/kg	63 12/24/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/kg	26 12/24/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/kg	18 12/24/97 MJW 75-34-3
Chloroform	ND ug/kg	13 12/24/97 MJW 67-66-3
1,1,1-Trichloroethane	ND ug/kg	13 12/24/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/kg	30 12/24/97 MJW 56-23-5
Benzene	ND ug/kg	49 12/24/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/kg	13 12/24/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/kg	85 12/24/97 MJW 10061-01-5
Trichloroethene	ND ug/kg	30 12/24/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/kg	13 12/24/97 MJW 78-87-5
Bromodichloromethane	ND ug/kg	26 12/24/97 MJW 75-27-4
Toluene	ND ug/kg	49 12/24/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/kg	13 12/24/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/kg	15 12/24/97 MJW 10061-02-6
Tetrachloroethene	ND ug/kg	13 12/24/97 MJW 127-18-4
Dibromochloromethane	ND ug/kg	24 12/24/97 MJW 124-48-1
Chlorobenzene	ND ug/kg	17 12/24/97 MJW 108-90-7
Ethylbenzene	ND ug/kg	49 12/24/97 MJW 100-41-4
Formoform	ND ug/kg	49 12/24/97 MJW 75-25-2

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9608 Lorret Blvd  
Lenexa, KS 66219

Tel 913-599-5665  
Fax 913-599-1759

DATE: 12/29/97

PAGE: 2

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Pace Sample No: 601638414 Date Collected: 12/10/97 Matrix: Soil  
Client Sample ID: P18-S-10 Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
1,1,2,2-Tetrachloroethane	ND	ug/kg	13	12/24/97	MJW	79-34-5	
Xylene (Total)	ND	ug/kg	170	12/24/97	MJW	1330-20-7	
1,3-Dichlorobenzene	ND	ug/kg	26	12/24/97	MJW	541-73-1	
1,4-Dichlorobenzene	ND	ug/kg	26	12/24/97	MJW	106-46-7	
1,2-Dichlorobenzene	ND	ug/kg	26	12/24/97	MJW	95-50-1	
Naphthalene	ND	ug/kg	120	12/24/97	MJW	91-20-3	
Methyl-tert-butyl Ether	ND	ug/kg	260	12/24/97	MJW	1634-04-4	
Dichlorodifluoromethane	ND	ug/kg	69	12/24/97	MJW	75-71-8	
a,a,a-Trifluorotoluene (S)	84	μ		12/24/97	MJW	2164-17-2	
1,4-Dichlorobutane (S)	97	μ		12/24/97	MJW	110-56-5	

GC -- Semi-VOA

Total Extractable Hydrocarbons	Method: OA2	Prep Method: OA2
Mineral Spirits	ND mg/kg 9.9	12/20/97 EMA
Jet Fuel	ND mg/kg 9.9	12/20/97 EMA
Kerosene	ND mg/kg 9.9	12/20/97 EMA
Diesel Fuel	ND mg/kg 9.9	12/20/97 EMA 11-84-7...
Fuel Oil	ND mg/kg 9.9	12/20/97 EMA
Motor Oil	ND mg/kg 9.9	12/20/97 EMA
n-Tetracosane (S)	92 μ	12/20/97 EMA 646-31-1
p-Terphenyl (S)	95 μ	12/20/97 EMA 92-94-4
Date Extracted		12/18/97

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# Pace Analytical

Pace Analytical Services, Inc

9608 Lorret Blvd

Lenexa, KS 66219

Tel 913-599-5665

Fax 913-599-1759

DATE: 12/29/97

PAGE: 3

Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638455	Date Collected:	12/10/97	Matrix:	Water
Client Sample ID:	P18-W-1D	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
------------	---------	-------	-----	----------	---------	------	-----------

## GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: EPA 8021
Chloromethane	ND ug/L 0.8	12/20/97 MJW 74-87-3
Vinyl Chloride	ND ug/L 1.8	12/20/97 MJW 75-01-4
Bromomethane	ND ug/L 3	12/20/97 MJW 74-83-9
Chloroethane	ND ug/L 5.2	12/20/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/L 5	12/20/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/L 1.3	12/20/97 MJW 75-35-4
Methylene Chloride	ND ug/L 2.5	12/20/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/L 1	12/20/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/L 0.7	12/20/97 MJW 75-34-3
Chloroform	ND ug/L 0.5	12/20/97 MJW 67-66-3
1,1-Trichloroethane	ND ug/L 0.5	12/20/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/L 1.2	12/20/97 MJW 56-23-5
Benzene	ND ug/L 2	12/20/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/L 0.5	12/20/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/L 3.4	12/20/97 MJW 10061-01-5
Trichloroethene	ND ug/L 1.2	12/20/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/L 0.5	12/20/97 MJW 78-87-5
Bromodichloromethane	ND ug/L 1	12/20/97 MJW 75-27-4
Toluene	ND ug/L 2	12/20/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/L 0.5	12/20/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/L 0.6	12/20/97 MJW 10061-02-6
Tetrachloroethene	ND ug/L 0.5	12/20/97 MJW 127-18-4
Dibromochloromethane	ND ug/L 0.9	12/20/97 MJW 124-48-1
Chlorobenzene	ND ug/L 0.7	12/20/97 MJW 108-90-7
Ethylbenzene	ND ug/L 2	12/20/97 MJW 100-41-4
Bromoform	ND ug/L 2	12/20/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/L 0.5	12/20/97 MJW 79-34-5
Xylene (Total)	ND ug/L 7	12/20/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/L 1	12/20/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/L 1	12/20/97 MJW 106-46-7
1,2-Dichlorobenzene	ND ug/L 1	12/20/97 MJW 95-50-1
Naphthalene	ND ug/L 5	12/20/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/L 10	12/20/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/L 5	12/20/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	93 x	12/20/97 MJW 2164-17-2
4-Dichlorobutane (S)	98 x	12/20/97 MJW 110-56-5

## GC -- Semi-VOA

## REPORT OF LABORATORY ANALYSIS

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# Pace Analytical

Pace Analytical Services, Inc.  
9608 Loiret Blvd.  
Lenexa, KS 66219

Tel 913-599-5665  
Fax 913-599-1759

DATE: 12/29/97

PAGE: 4

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Pace Sample No: 601638455 Date Collected: 12/10/97 Matrix: Water  
Client Sample ID: P18-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
Total Extractable Hydrocarbons	Method: OA2				Prep Method: OA2		
Mineral Spirits	ND	mg/L	0.4	12/19/97	EMA		
Jet Fuel	ND	mg/L	0.4	12/19/97	EMA		
Kerosene	ND	mg/L	0.4	12/19/97	EMA		
Diesel Fuel	ND	mg/L	0.4	12/19/97	EMA	11-84-7...	
Fuel Oil	ND	mg/L	0.4	12/19/97	EMA		
Motor Oil	ND	mg/L	0.4	12/19/97	EMA		
p-Terphenyl (S)	93	μ		12/19/97	EMA	92-94-4	
n-Tetracosane (S)	87	μ		12/19/97	EMA	646-31-1	
Date Extracted				12/17/97			

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DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No: 601638463 Date Collected: 12/10/97 Matrix: Water  
Client Sample ID: TRIP BLANK Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: EPA 8021
Chloromethane	ND ug/L 0.8	12/21/97 MJW 74-87-3
Vinyl Chloride	ND ug/L 1.8	12/21/97 MJW 75-01-4
Bromomethane	ND ug/L 3	12/21/97 MJW 74-83-9
Chloroethane	ND ug/L 5.2	12/21/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/L 5	12/21/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/L 1.3	12/21/97 MJW 75-35-4
Methylene Chloride	ND ug/L 2.5	12/21/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/L 1	12/21/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/L 0.7	12/21/97 MJW 75-34-3
Chloroform	ND ug/L 0.5	12/21/97 MJW 67-66-3
1,1-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/L 1.2	12/21/97 MJW 56-23-5
Benzene	ND ug/L 2	12/21/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/L 0.5	12/21/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/L 3.4	12/21/97 MJW 10061-01-5
Trichloroethene	ND ug/L 1.2	12/21/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/L 0.5	12/21/97 MJW 78-87-5
Bromodichloromethane	ND ug/L 1	12/21/97 MJW 75-27-4
Toluene	ND ug/L 2	12/21/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/L 0.6	12/21/97 MJW 10061-02-6
Tetrachloroethene	ND ug/L 0.5	12/21/97 MJW 127-18-4
Dibromochloromethane	ND ug/L 0.9	12/21/97 MJW 124-48-1
Chlorobenzene	ND ug/L 0.7	12/21/97 MJW 108-90-7
Ethylbenzene	ND ug/L 2	12/21/97 MJW 100-41-4
Bromoform	ND ug/L 2	12/21/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	0.92 ug/L 0.5	12/21/97 MJW 79-34-5
Xylene (Total)	ND ug/L 7	12/21/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 106-46-7
1,2-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 95-50-1
Naphthalene	ND ug/L 5	12/21/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/L 10	12/21/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/L 5	12/21/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	94 ug/L 1	12/21/97 MJW 2164-17-2
4-Dichlorobutane (S)	96 ug/L 1	12/21/97 MJW 110-56-5

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DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638471	Date Collected:	12/11/97	Matrix:	Soil
Client Sample ID:	P7-S-1D	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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## GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: 5030 Med Lvl Soil
Chloromethane	440 ug/kg	20 12/24/97 MJW 74-87-3 1
Vinyl Chloride	ND ug/kg	46 12/24/97 MJW 75-01-4
Bromomethane	ND ug/kg	76 12/24/97 MJW 74-83-9
Chloroethane	ND ug/kg	130 12/24/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/kg	130 12/24/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/kg	34 12/24/97 MJW 75-35-4
Methylene Chloride	ND ug/kg	64 12/24/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/kg	26 12/24/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/kg	18 12/24/97 MJW 75-34-3
Chloroform	ND ug/kg	13 12/24/97 MJW 67-66-3
1,1-Trichloroethane	ND ug/kg	13 12/24/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/kg	30 12/24/97 MJW 56-23-5
Benzene	ND ug/kg	50 12/24/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/kg	13 12/24/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/kg	86 12/24/97 MJW 10061-01-5
Trichloroethene	ND ug/kg	30 12/24/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/kg	13 12/24/97 MJW 78-87-5
Bromodichloromethane	ND ug/kg	26 12/24/97 MJW 75-27-4
Toluene	ND ug/kg	50 12/24/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/kg	13 12/24/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/kg	15 12/24/97 MJW 10061-02-6
Tetrachloroethene	ND ug/kg	13 12/24/97 MJW 127-18-4
Dibromochloromethane	ND ug/kg	24 12/24/97 MJW 124-48-1
Chlorobenzene	ND ug/kg	18 12/24/97 MJW 108-90-7
Ethylbenzene	ND ug/kg	50 12/24/97 MJW 100-41-4
Bromoform	ND ug/kg	50 12/24/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/kg	13 12/24/97 MJW 79-34-5
Xylene (Total)	ND ug/kg	180 12/24/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/kg	26 12/24/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/kg	26 12/24/97 MJW 106-46-7
1,2-Dichlorobenzene	ND ug/kg	26 12/24/97 MJW 95-50-1
Naphthalene	ND ug/kg	130 12/24/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/kg	260 12/24/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/kg	70 12/24/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	87 ug/kg	12/24/97 MJW 2164-17-2
4-Dichlorobutane (S)	102 ug/kg	12/24/97 MJW 110-56-5

## GC -- Semi-VOA

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638471	Date Collected:	12/11/97	Matrix:	Soil
Client Sample ID:	P7-S-1D	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
Total Extractable Hydrocarbons	Method: OA2				Prep Method: OA2		
Mineral Spirits	ND	mg/kg	8.8	12/20/97	EMA		
Jet Fuel	ND	mg/kg	8.8	12/20/97	EMA		
Kerosene	ND	mg/kg	8.8	12/20/97	EMA		
Diesel Fuel	ND	mg/kg	8.8	12/20/97	EMA	11-84-7...	
Fuel Oil	ND	mg/kg	8.8	12/20/97	EMA		
Motor Oil	ND	mg/kg	8.8	12/20/97	EMA		
n-Tetracosane (S)	96	%		12/20/97	EMA	646-31-1	
p-Terphenyl (S)	103	%		12/20/97	EMA	92-94-4	
Date Extracted				12/19/97			

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No: 601638489 Date Collected: 12/11/97 Matrix: Water  
Client Sample ID: P7-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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## GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: EPA 8021
Chloromethane	ND ug/L 0.8	12/21/97 MJW 74-87-3
Vinyl Chloride	ND ug/L 1.8	12/21/97 MJW 75-01-4
Bromomethane	ND ug/L 3	12/21/97 MJW 74-83-9
Chloroethane	ND ug/L 5.2	12/21/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/L 5	12/21/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/L 1.3	12/21/97 MJW 75-35-4
Methylene Chloride	ND ug/L 2.5	12/21/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/L 1	12/21/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/L 0.7	12/21/97 MJW 75-34-3
Chloroform	1.4 ug/L 0.5	12/21/97 MJW 67-66-3
1,1,1-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/L 1.2	12/21/97 MJW 56-23-5
Benzene	ND ug/L 2	12/21/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/L 0.5	12/21/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/L 3.4	12/21/97 MJW 10061-01-5
Trichloroethene	ND ug/L 1.2	12/21/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/L 0.5	12/21/97 MJW 78-87-5
Bromodichloromethane	ND ug/L 1	12/21/97 MJW 75-27-4
Toluene	ND ug/L 2	12/21/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/L 0.6	12/21/97 MJW 10061-02-6
Tetrachloroethene	ND ug/L 0.5	12/21/97 MJW 127-18-4
Dibromochloromethane	ND ug/L 0.9	12/21/97 MJW 124-48-1
Chlorobenzene	ND ug/L 0.7	12/21/97 MJW 108-90-7
Ethylbenzene	ND ug/L 2	12/21/97 MJW 100-41-4
Bromoform	ND ug/L 2	12/21/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/L 0.5	12/21/97 MJW 79-34-5
Xylene (Total)	ND ug/L 7	12/21/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 106-46-7
1,2-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 95-50-1
Naphthalene	ND ug/L 5	12/21/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/L 10	12/21/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/L 5	12/21/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	94 %	12/21/97 MJW 2164-17-2
4-Dichlorobutane (S)	102 %	12/21/97 MJW 110-56-5

GC -- Semi-VOA

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DATE: 12/29/97

PAGE: 9

Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No: 601638489 Date Collected: 12/11/97 Matrix: Water  
Client Sample ID: P7-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
Total Extractable Hydrocarbons	Method: OA2				Prep Method: OA2		
Mineral Spirits	ND	mg/L	0.4	12/19/97	EMA		
Jet Fuel	ND	mg/L	0.4	12/19/97	EMA		
Kerosene	ND	mg/L	0.4	12/19/97	EMA		
Diesel Fuel	ND	mg/L	0.4	12/19/97	EMA	11-84-7...	
Fuel Oil	ND	mg/L	0.4	12/19/97	EMA		
Motor Oil	ND	mg/L	0.4	12/19/97	EMA		
p-Terphenyl (S)	93	μ		12/19/97	EMA	92-94-4	
n-Tetracosane (S)	87	μ		12/19/97	EMA	646-31-1	
Date Extracted				12/17/97			

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638497	Date Collected:	12/12/97	Matrix:	Soil
Client Sample ID:	P14-S-1D	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: 5030 Med Lvl Soil
Chloromethane	420 ug/kg	20 12/24/97 MJW 74-87-3 1
Vinyl Chloride	ND ug/kg	46 12/24/97 MJW 75-01-4
Bromomethane	ND ug/kg	76 12/24/97 MJW 74-83-9
Chloroethane	ND ug/kg	130 12/24/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/kg	130 12/24/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/kg	34 12/24/97 MJW 75-35-4
Methylene Chloride	ND ug/kg	64 12/24/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/kg	26 12/24/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/kg	18 12/24/97 MJW 75-34-3
Chloroform	ND ug/kg	13 12/24/97 MJW 67-66-3
1,1-Trichloroethane	ND ug/kg	13 12/24/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/kg	30 12/24/97 MJW 56-23-5
Benzene	ND ug/kg	50 12/24/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/kg	13 12/24/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/kg	86 12/24/97 MJW 10061-01-5
Trichloroethene	ND ug/kg	30 12/24/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/kg	13 12/24/97 MJW 78-87-5
Bromodichloromethane	ND ug/kg	26 12/24/97 MJW 75-27-4
Toluene	ND ug/kg	50 12/24/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/kg	13 12/24/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/kg	15 12/24/97 MJW 10061-02-6
Tetrachloroethene	ND ug/kg	13 12/24/97 MJW 127-18-4
Dibromochloromethane	ND ug/kg	24 12/24/97 MJW 124-48-1
Chlorobenzene	ND ug/kg	18 12/24/97 MJW 108-90-7
Ethylbenzene	ND ug/kg	50 12/24/97 MJW 100-41-4
Bromoform	ND ug/kg	50 12/24/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/kg	13 12/24/97 MJW 79-34-5
Xylene (Total)	ND ug/kg	180 12/24/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/kg	26 12/24/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/kg	26 12/24/97 MJW 106-46-7
1,2-Dichlorobenzene	ND ug/kg	26 12/24/97 MJW 95-50-1
Naphthalene	130 ug/kg	130 12/24/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/kg	260 12/24/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/kg	70 12/24/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	86 ug/kg	12/24/97 MJW 2164-17-2
1,4-Dichlorobutane (S)	97 ug/kg	12/24/97 MJW 110-56-5

GC -- Semi-VOA

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638497	Date Collected:	12/12/97	Matrix:	Soil
Client Sample ID:	P14-S-1D	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
Total Extractable Hydrocarbons	Method: OA2				Prep Method: OA2		
Mineral Spirits	ND	mg/kg	8.5	12/20/97	EMA		
Jet Fuel	ND	mg/kg	8.5	12/20/97	EMA		
Kerosene	ND	mg/kg	8.5	12/20/97	EMA		
Diesel Fuel	ND	mg/kg	8.5	12/20/97	EMA	11-84-7...	
Fuel Oil	ND	mg/kg	8.5	12/20/97	EMA		
Motor Oil	ND	mg/kg	8.5	12/20/97	EMA		
n-Tetracosane (S)	94	μ		12/20/97	EMA	646-31-1	
p-Terphenyl (S)	98	μ		12/20/97	EMA	92-94-4	
Date Extracted				12/19/97			

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Pace Sample No: 601638505 Date Collected: 12/12/97 Matrix: Water  
Client Sample ID: P14-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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## GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021			Prep Method: EPA 8021		
Chloromethane	ND	ug/L	0.8	12/21/97	MJW	74-87-3
Vinyl Chloride	ND	ug/L	1.8	12/21/97	MJW	75-01-4
Bromomethane	ND	ug/L	3	12/21/97	MJW	74-83-9
Chloroethane	ND	ug/L	5.2	12/21/97	MJW	75-00-3
Trichlorofluoromethane	ND	ug/L	5	12/21/97	MJW	75-69-4
1,1-Dichloroethene	ND	ug/L	1.3	12/21/97	MJW	75-35-4
Methylene Chloride	ND	ug/L	2.5	12/21/97	MJW	75-09-2
trans-1,2-Dichloroethene	ND	ug/L	1	12/21/97	MJW	156-60-5
1,1-Dichloroethane	ND	ug/L	0.7	12/21/97	MJW	75-34-3
Chloroform	ND	ug/L	0.5	12/21/97	MJW	67-66-3
1,1,1-Trichloroethane	ND	ug/L	0.5	12/21/97	MJW	71-55-6
Carbon Tetrachloride	ND	ug/L	1.2	12/21/97	MJW	56-23-5
Benzene	ND	ug/L	2	12/21/97	MJW	71-43-2
1,2-Dichloroethane	ND	ug/L	0.5	12/21/97	MJW	107-06-2
cis-1,3-Dichloropropene	ND	ug/L	3.4	12/21/97	MJW	10061-01-5
Trichloroethene	ND	ug/L	1.2	12/21/97	MJW	79-01-6
1,2-Dichloropropane	ND	ug/L	0.5	12/21/97	MJW	78-87-5
Bromodichloromethane	ND	ug/L	1	12/21/97	MJW	75-27-4
Toluene	ND	ug/L	2	12/21/97	MJW	108-88-3
1,1,2-Trichloroethane	ND	ug/L	0.5	12/21/97	MJW	79-00-5
trans-1,3-Dichloropropene	ND	ug/L	0.6	12/21/97	MJW	10061-02-6
Tetrachloroethene	ND	ug/L	0.5	12/21/97	MJW	127-18-4
Dibromochloromethane	ND	ug/L	0.9	12/21/97	MJW	124-48-1
Chlorobenzene	ND	ug/L	0.7	12/21/97	MJW	108-90-7
Ethylbenzene	ND	ug/L	2	12/21/97	MJW	100-41-4
Bromoform	ND	ug/L	2	12/21/97	MJW	75-25-2
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	12/21/97	MJW	79-34-5
Xylene (Total)	ND	ug/L	7	12/21/97	MJW	1330-20-7
1,3-Dichlorobenzene	ND	ug/L	1	12/21/97	MJW	541-73-1
1,4-Dichlorobenzene	ND	ug/L	1	12/21/97	MJW	106-46-7
1,2-Dichlorobenzene	ND	ug/L	1	12/21/97	MJW	95-50-1
Naphthalene	ND	ug/L	5	12/21/97	MJW	91-20-3
Methyl-tert-butyl Ether	ND	ug/L	10	12/21/97	MJW	1634-04-4
Dichlorodifluoromethane	ND	ug/L	5	12/21/97	MJW	75-71-8
a,a,a-Trifluorotoluene (S)	93	μ		12/21/97	MJW	2164-17-2
4-Dichlorobutane (S)	103	μ		12/21/97	MJW	110-56-5

## GC -- Semi-VOA

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Pace Analytical Services, Inc.  
9608 Loiret Blvd  
Lenexa, KS 66219

Tel 913-599-5665

Fax 913-599-1759

DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No: 601638505 Date Collected: 12/12/97 Matrix: Water  
Client Sample ID: P14-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
Total Extractable Hydrocarbons	Method: OA2				Prep Method: OA2		
Mineral Spirits	ND	mg/L	0.4	12/19/97	EMA		
Jet Fuel	ND	mg/L	0.4	12/19/97	EMA		
Kerosene	ND	mg/L	0.4	12/19/97	EMA		
Diesel Fuel	ND	mg/L	0.4	12/19/97	EMA	11-84-7...	
Fuel Oil	ND	mg/L	0.4	12/19/97	EMA		
Motor Oil	ND	mg/L	0.4	12/19/97	EMA		
p-Terphenyl (S)	96	μ		12/19/97	EMA	92-94-4	
n-Tetracosane (S)	83	μ		12/19/97	EMA	646-31-1	
Date Extracted				12/17/97			

## REPORT OF LABORATORY ANALYSIS

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DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No: 601638513 Date Collected: 12/12/97 Matrix: Water  
Client Sample ID: P2-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: EPA 8021
Chloromethane	ND ug/L 0.8	12/21/97 MJW 74-87-3
Vinyl Chloride	ND ug/L 1.8	12/21/97 MJW 75-01-4
Bromomethane	ND ug/L 3	12/21/97 MJW 74-83-9
Chloroethane	ND ug/L 5.2	12/21/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/L 5	12/21/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/L 1.3	12/21/97 MJW 75-35-4
Methylene Chloride	ND ug/L 2.5	12/21/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/L 1	12/21/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/L 0.7	12/21/97 MJW 75-34-3
Chloroform	ND ug/L 0.5	12/21/97 MJW 67-66-3
1,1-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/L 1.2	12/21/97 MJW 56-23-5
Benzene	12 ug/L 2	12/21/97 MJW 71-43-2
1,2-Dichloroethane	4.8 ug/L 0.5	12/21/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/L 3.4	12/21/97 MJW 10061-01-5
Trichloroethene	ND ug/L 1.2	12/21/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/L 0.5	12/21/97 MJW 78-87-5
Bromodichloromethane	ND ug/L 1	12/21/97 MJW 75-27-4
Toluene	2.9 ug/L 2	12/21/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/L 0.6	12/21/97 MJW 10061-02-6
Tetrachloroethene	ND ug/L 0.5	12/21/97 MJW 127-18-4
Dibromochloromethane	ND ug/L 0.9	12/21/97 MJW 124-48-1
Chlorobenzene	2.5 ug/L 0.7	12/21/97 MJW 108-90-7
Ethylbenzene	ND ug/L 2	12/21/97 MJW 100-41-4
Bromoform	ND ug/L 2	12/21/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/L 0.5	12/21/97 MJW 79-34-5
Xylene (Total)	7.5 ug/L 7	12/21/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 106-46-7
1,2-Dichlorobenzene	2.6 ug/L 1	12/21/97 MJW 95-50-1
Naphthalene	ND ug/L 5	12/21/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/L 10	12/21/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/L 5	12/21/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	192 ug/L 1	12/21/97 MJW 2164-17-2
1,4-Dichlorobutane (S)	100 ug/L 1	12/21/97 MJW 110-56-5

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GC -- Semi-VOA

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638513	Date Collected:	12/12/97	Matrix:	Water
Client Sample ID:	P2-W-10	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
Total Extractable Hydrocarbons	Method: OA2				Prep Method: OA2		
Mineral Spirits	ND	mg/L	0.4	12/19/97	EMA		
Jet Fuel	ND	mg/L	0.4	12/19/97	EMA		
Kerosene	ND	mg/L	0.4	12/19/97	EMA		
Diesel Fuel	ND	mg/L	0.4	12/19/97	EMA	11-84-7...	
Fuel Oil	ND	mg/L	0.4	12/19/97	EMA		
Motor Oil	ND	mg/L	0.4	12/19/97	EMA		
p-Terphenyl (S)	84	%		12/19/97	EMA	92-94-4	
n-Tetracosane (S)	76	%		12/19/97	EMA	646-31-1	
Date Extracted				12/17/97			

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Pace Sample No: 601638521 Date Collected: 12/13/97 Matrix: Water  
Client Sample ID: P3-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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## GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: EPA 8021
Chloromethane	ND ug/L 0.8	12/21/97 MJW 74-87-3
Vinyl Chloride	ND ug/L 1.8	12/21/97 MJW 75-01-4
Bromomethane	ND ug/L 3	12/21/97 MJW 74-83-9
Chloroethane	ND ug/L 5.2	12/21/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/L 5	12/21/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/L 1.3	12/21/97 MJW 75-35-4
Methylene Chloride	ND ug/L 2.5	12/21/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/L 1	12/21/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/L 0.7	12/21/97 MJW 75-34-3
Chloroform	ND ug/L 0.5	12/21/97 MJW 67-66-3
1,1-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/L 1.2	12/21/97 MJW 56-23-5
Benzene	ND ug/L 2	12/21/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/L 0.5	12/21/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/L 3.4	12/21/97 MJW 10061-01-5
Trichloroethene	ND ug/L 1.2	12/21/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/L 0.5	12/21/97 MJW 78-87-5
Bromodichloromethane	ND ug/L 1	12/21/97 MJW 75-27-4
Toluene	ND ug/L 2	12/21/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/L 0.6	12/21/97 MJW 10061-02-6
Tetrachloroethene	ND ug/L 0.5	12/21/97 MJW 127-18-4
Dibromochloromethane	ND ug/L 0.9	12/21/97 MJW 124-48-1
Chlorobenzene	ND ug/L 0.7	12/21/97 MJW 108-90-7
Ethylbenzene	ND ug/L 2	12/21/97 MJW 100-41-4
Bromoform	ND ug/L 2	12/21/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/L 0.5	12/21/97 MJW 79-34-5
Xylene (Total)	ND ug/L 7	12/21/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 106-46-7
1,2-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 95-50-1
Naphthalene	ND ug/L 5	12/21/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/L 10	12/21/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/L 5	12/21/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	93 x	12/21/97 MJW 2164-17-2
4-Dichlorobutane (S)	104 x	12/21/97 MJW 110-56-5

## GC -- Semi-VOA

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DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638521	Date Collected:	12/13/97	Matrix:	Water
Client Sample ID:	P3-W-10	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
Total Extractable Hydrocarbons	Method: OA2				Prep Method: OA2		
Mineral Spirits	ND	mg/L	0.4	12/19/97	EMA		
Jet Fuel	ND	mg/L	0.4	12/19/97	EMA		
Kerosene	ND	mg/L	0.4	12/19/97	EMA		
Diesel Fuel	ND	mg/L	0.4	12/19/97	EMA	11-84-7...	
Fuel Oil	ND	mg/L	0.4	12/19/97	EMA		
Motor Oil	ND	mg/L	0.4	12/19/97	EMA		
p-Terphenyl (S)	103	μ		12/19/97	EMA	92-94-4	
n-Tetracosane (S)	94	μ		12/19/97	EMA	646-31-1	
Date Extracted				12/17/97			

## REPORT OF LABORATORY ANALYSIS

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DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

Pace Sample No:	601638547	Date Collected:	12/13/97	Matrix:	Water
Client Sample ID:	P15-W-1D	Date Received:	12/14/97		

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: EPA 8021
Chloromethane	ND ug/L 0.8	12/21/97 MJW 74-87-3
Vinyl Chloride	ND ug/L 1.8	12/21/97 MJW 75-01-4
Bromomethane	ND ug/L 3	12/21/97 MJW 74-83-9
Chloroethane	ND ug/L 5.2	12/21/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/L 5	12/21/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/L 1.3	12/21/97 MJW 75-35-4
Methylene Chloride	ND ug/L 2.5	12/21/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/L 1	12/21/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/L 0.7	12/21/97 MJW 75-34-3
Chloroform	ND ug/L 0.5	12/21/97 MJW 67-66-3
1,1,1-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/L 1.2	12/21/97 MJW 56-23-5
Benzene	ND ug/L 2	12/21/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/L 0.5	12/21/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/L 3.4	12/21/97 MJW 10061-01-5
Trichloroethene	ND ug/L 1.2	12/21/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/L 0.5	12/21/97 MJW 78-87-5
Bromodichloromethane	ND ug/L 1	12/21/97 MJW 75-27-4
Toluene	ND ug/L 2	12/21/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/L 0.6	12/21/97 MJW 10061-02-6
Tetrachloroethene	ND ug/L 0.5	12/21/97 MJW 127-18-4
Dibromochloromethane	ND ug/L 0.9	12/21/97 MJW 124-48-1
Chlorobenzene	ND ug/L 0.7	12/21/97 MJW 108-90-7
Ethylbenzene	ND ug/L 2	12/21/97 MJW 100-41-4
Bromoform	ND ug/L 2	12/21/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/L 0.5	12/21/97 MJW 79-34-5
Xylene (Total)	ND ug/L 7	12/21/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 541-73-1
1,4-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 106-46-7
1,2-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 95-50-1
Naphthalene	ND ug/L 5	12/21/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/L 10	12/21/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/L 5	12/21/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	97	12/21/97 MJW 2164-17-2
4-Dichlorobutane (S)	82	12/21/97 MJW 110-56-5

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DATE: 12/29/97

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Pace Project Number: 6019010  
Client Project ID: Marco, KS

Pace Sample No: 601638554 Date Collected: 12/13/97 Matrix: Water  
Client Sample ID: P20-W-1D Date Received: 12/14/97

Parameters	Results	Units	PRL	Analyzed	Analyst	CAS#	Footnotes
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GC -- Volatiles

Halogen. & Aromatic Vol. Orgs.	Method: EPA 8021	Prep Method: EPA 8021
Chloromethane	ND ug/L 0.8	12/21/97 MJW 74-87-3
Vinyl Chloride	ND ug/L 1.8	12/21/97 MJW 75-01-4
Bromomethane	ND ug/L 3	12/21/97 MJW 74-83-9
Chloroethane	ND ug/L 5.2	12/21/97 MJW 75-00-3
Trichlorofluoromethane	ND ug/L 5	12/21/97 MJW 75-69-4
1,1-Dichloroethene	ND ug/L 1.3	12/21/97 MJW 75-35-4
Methylene Chloride	ND ug/L 2.5	12/21/97 MJW 75-09-2
trans-1,2-Dichloroethene	ND ug/L 1	12/21/97 MJW 156-60-5
1,1-Dichloroethane	ND ug/L 0.7	12/21/97 MJW 75-34-3
Chloroform	ND ug/L 0.5	12/21/97 MJW 67-66-3
1,1,1-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 71-55-6
Carbon Tetrachloride	ND ug/L 1.2	12/21/97 MJW 56-23-5
Benzene	ND ug/L 2	12/21/97 MJW 71-43-2
1,2-Dichloroethane	ND ug/L 0.5	12/21/97 MJW 107-06-2
cis-1,3-Dichloropropene	ND ug/L 3.4	12/21/97 MJW 10061-01-5
Trichloroethene	ND ug/L 1.2	12/21/97 MJW 79-01-6
1,2-Dichloropropane	ND ug/L 0.5	12/21/97 MJW 78-87-5
Bromodichloromethane	ND ug/L 1	12/21/97 MJW 75-27-4
Toluene	ND ug/L 2	12/21/97 MJW 108-88-3
1,1,2-Trichloroethane	ND ug/L 0.5	12/21/97 MJW 79-00-5
trans-1,3-Dichloropropene	ND ug/L 0.6	12/21/97 MJW 10061-02-6
Tetrachloroethene	ND ug/L 0.5	12/21/97 MJW 127-18-4
Dibromochloromethane	ND ug/L 0.9	12/21/97 MJW 124-48-1
Chlorobenzene	0.71 ug/L 0.7	12/21/97 MJW 108-90-7
Ethylbenzene	ND ug/L 2	12/21/97 MJW 100-41-4
Bromoform	ND ug/L 2	12/21/97 MJW 75-25-2
1,1,2,2-Tetrachloroethane	ND ug/L 0.5	12/21/97 MJW 79-34-5
Xylene (Total)	ND ug/L 7	12/21/97 MJW 1330-20-7
1,3-Dichlorobenzene	ND ug/L 1	12/21/97 MJW 541-73-1
1,4-Dichlorobenzene	1.1 ug/L 1	12/21/97 MJW 106-46-7
1,2-Dichlorobenzene	2.2 ug/L 1	12/21/97 MJW 95-50-1
Naphthalene	ND ug/L 5	12/21/97 MJW 91-20-3
Methyl-tert-butyl Ether	ND ug/L 10	12/21/97 MJW 1634-04-4
Dichlorodifluoromethane	ND ug/L 5	12/21/97 MJW 75-71-8
a,a,a-Trifluorotoluene (S)	115 %	12/21/97 MJW 2164-17-2
1,4-Dichlorobutane (S)	103 %	12/21/97 MJW 110-56-5

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DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

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## PARAMETER FOOTNOTES

ND Not Detected  
NC Not Calculable  
PRL Pace Reporting Limit  
(S) Surrogate  
[1] Analyte is found in the associated blank as well as in the sample (CLP B-Flag).  
[2] Matrix interference of a,a,a-trifluorotoluene is indicated by the 145% recovery of the secondary surrogate bromochlorobenzene.

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Lenexa, KS 66219  
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## QUALITY CONTROL DATA

DATE: 12/29/97  
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GOLDER ASSOCIATES INC  
200 UNION BOULEVARD  
SUITE 500  
LAKEWOOD, CO 80228

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Attn: Mr. RANDY MARCH  
Phone: (303)980-0540

QC Batch ID: 39877                      QC Batch Method: OA2  
Analysis Method: OA2                  Analysis Description: Total Extractable Hydrocarbons  
Associated Pace Samples:              601638455    601638489    601638505    601638513    601638521

METHOD BLANK: 601638562

Associated Pace Samples:

601638455    601638489    601638505    601638513    601638521

Parameter	Units	Method Blank Result	PRL	Footnotes
Methyl Spirits	mg/L	ND	0.4	
Jet Fuel	mg/L	ND	0.4	
Kerosene	mg/L	ND	0.4	
Diesel Fuel	mg/L	ND	0.4	
Fuel Oil	mg/L	ND	0.4	
Motor Oil	mg/L	ND	0.4	
p-Terphenyl (S)	µg	95		
n-Tetracosane (S)	µg	88		

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 601638570    601638588									
Parameter	Units	601638455	Spike Conc.	Matrix Spike Result	Spike Sp. Dup. µg Rec	Matrix Sp. Dup. Result	Spike Dup µg Rec	RPD	Footnotes
Diesel Fuel	mg/L	0	12.5	11.19	89.5	12.62	101	12	
p-Terphenyl (S)					96		92		
n-Tetracosane (S)					90		89		

LABORATORY CONTROL SAMPLE: 601638596

Parameter	Units	Spike Conc.	LCS Result	Spike µg Rec	Footnotes
Diesel Fuel	mg/L	12.5	11.58	92.7	
p-Terphenyl (S)				101	

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## QUALITY CONTROL DATA

DATE: 12/29/97

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Pace Project Number: 6019010

Client Project ID: Marco, KS

LABORATORY CONTROL SAMPLE: 601638596

Parameter	Units	Spike Conc.	LCS Result	Spike % Rec	Footnotes
n-Tetracosane (S)				95	

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## QUALITY CONTROL DATA

DATE: 12/29/97  
PAGE: 23

GOLDER ASSOCIATES INC  
200 UNION BOULEVARD  
SUITE 500  
LAKEWOOD, CO 80228

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Attn: Mr. RANDY MARCH  
Phone: (303)980-0540

QC Batch ID: 39930  
Analysis Method: OA2  
Associated Pace Samples: 601638414

QC Batch Method: OA2  
Analysis Description: Total Extractable Hydrocarbons

METHOD BLANK: 601641798  
Associated Pace Samples:

601638414

Parameter	Units	Method Blank Result	PRL	Footnotes
Motor Oil	mg/kg	ND	10	
Jet Fuel	mg/kg	ND	10	
Kerosene	mg/kg	ND	10	
Diesel Fuel	mg/kg	ND	10	
Fuel Oil	mg/kg	ND	10	
Motor Oil	mg/kg	ND	10	
n-Tetracosane (S)	μ	83		
p-Terphenyl (S)	μ	82		

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 601641806 601641814									
Parameter	Units	601620024	Spike Conc.	Matrix Spike Result	Spike Sp. Rec	Matrix Sp. Dup. Result	Spike Dup μ Rec	RPD	Footnotes
Diesel Fuel	mg/kg	0	495	400.9	81.0	472.1	95.0	16	
n-Tetracosane (S)					76		79		
p-Terphenyl (S)					82		84		

LABORATORY CONTROL SAMPLE: 601641822

Parameter	Units	Spike Conc.	LCS Result	Spike μ Rec	Footnotes
Diesel Fuel	mg/kg	500	451.6	90.3	
n-Tetracosane (S)				77	

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## QUALITY CONTROL DATA

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Pace Project Number: 6019010  
Client Project ID: Marco, KS

LABORATORY CONTROL SAMPLE: 601641822

Parameter	Units	Spike Conc.	LCS Result	Spike ± Rec	Footnotes
p-Terphenyl (S)				82	

## REPORT OF LABORATORY ANALYSIS

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## QUALITY CONTROL DATA

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GOLDER ASSOCIATES INC  
200 UNION BOULEVARD  
SUITE 500  
LAKEWOOD, CO 80228

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Attn: Mr. RANDY MARCH  
Phone: (303)980-0540

QC Batch ID: 40030                      QC Batch Method: OA2  
Analysis Method: OA2                  Analysis Description: Total Extractable Hydrocarbons  
Associated Pace Samples:              601638471      601638497

METHOD BLANK: 601645930  
Associated Pace Samples:

Parameter	Units	601638471	601638497	PRL	Footnotes
			Method Blank Result		
Methyl Spirits	mg/kg		ND	10	
Jet Fuel	mg/kg		ND	10	
Kerosene	mg/kg		ND	10	
Diesel Fuel	mg/kg		ND	10	
Fuel Oil	mg/kg		ND	10	
Motor Oil	mg/kg		ND	10	
n-Tetracosane (S)	%		99		
p-Terphenyl (S)	%		104		

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 601645948 601645955									
Parameter	Units	601633266	Spike Conc.	Matrix Spike Result	Spike Rec	Matrix Sp. Dup. Result	Spike Dup Rec	RPD	Footnotes
Diesel Fuel	mg/kg	0	489.2	448.7	91.7	475.8	98.8	7	
n-Tetracosane (S)					98		100		
p-Terphenyl (S)					103		106		

LABORATORY CONTROL SAMPLE: 601645963

Parameter	Units	Spike Conc.	LCS Result	Spike Rec	Footnotes
Diesel Fuel	mg/kg	500	468.3	93.7	
n-Tetracosane (S)				98	

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Pace Project Number: 6019010  
Client Project ID: Marco, KS

LABORATORY CONTROL SAMPLE: 601645963

Parameter	Units	Spike Conc.	LCS Result	Spike % Rec	Footnotes
p-Terphenyl (S)				104	

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## QUALITY CONTROL DATA

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GOLDER ASSOCIATES INC  
200 UNION BOULEVARD  
SUITE 500  
LAKEWOOD, CO 80228

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Attn: Mr. RANDY MARCH  
Phone: (303)980-0540

QC Batch ID: 40046  
Analysis Method: EPA 8021  
Associated Pace Samples: 601638455 601638463 601638489 601638505 601638513  
601638521 601638547 601638554

QC Batch Method: EPA 8021  
Analysis Description: Halogen. & Aromatic Vol. Orgs.

METHOD BLANK: 601648074

Associated Pace Samples:

601638455 601638463 601638489 601638505 601638513 601638521

Compound	Units	Method	PRL	Footnotes
		Blank Result		
Chloromethane	ug/L	ND	0.8	
Vinyl Chloride	ug/L	ND	1.8	
Bromomethane	ug/L	ND	3	
Chloroethane	ug/L	ND	5.2	
Trichlorofluoromethane	ug/L	ND	5	
1,1-Dichloroethene	ug/L	ND	1.3	
Methylene Chloride	ug/L	ND	2.5	
trans-1,2-Dichloroethene	ug/L	ND	1	
1,1-Dichloroethane	ug/L	ND	0.7	
Chloroform	ug/L	ND	0.5	
1,1,1-Trichloroethane	ug/L	ND	0.5	
Carbon Tetrachloride	ug/L	ND	1.2	
Benzene	ug/L	ND	2	
1,2-Dichloroethane	ug/L	ND	0.5	
cis-1,3-Dichloropropene	ug/L	ND	3.4	
Trichloroethene	ug/L	ND	1.2	
1,2-Dichloropropane	ug/L	ND	0.5	
Bromodichloromethane	ug/L	ND	1	
Toluene	ug/L	ND	2	
1,1,2-Trichloroethane	ug/L	ND	0.5	
trans-1,3-Dichloropropene	ug/L	ND	0.6	
Tetrachloroethene	ug/L	ND	0.5	
Dibromochloromethane	ug/L	ND	0.9	
p-benzene	ug/L	ND	0.7	

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Pace Project Number: 6019010

Client Project ID: Marco, KS

METHOD BLANK: 601648074

Associated Pace Samples:

601638455 601638463 601638489 601638505 601638513 601638521

Parameter	Units	Method Blank	PRL	Footnotes
		Result		
Ethylbenzene	ug/L	ND	2	
Bromoform	ug/L	ND	2	
1,1,2,2-Tetrachloroethane	ug/L	ND	0.5	
Xylene (Total)	ug/L	ND	7	
1,3-Dichlorobenzene	ug/L	ND	1	
1,4-Dichlorobenzene	ug/L	ND	1	
1,2-Dichlorobenzene	ug/L	ND	1	
Naphthalene	ug/L	ND	5	
Methyl-tert-butyl Ether	ug/L	ND	10	
Dichlorodifluoromethane	ug/L	ND	5	
a,a,a-Trifluorotoluene (S)	μ	94		
1,4-Dichlorobutane (S)	μ	103		

METHOD BLANK: 601650526

Associated Pace Samples:

601638547 601638554

Parameter	Units	Method Blank	PRL	Footnotes
		Result		
Chloromethane	ug/L	ND	0.8	
Vinyl Chloride	ug/L	ND	1.8	
Bromomethane	ug/L	ND	3	
Chloroethane	ug/L	ND	5.2	
Trichlorofluoromethane	ug/L	ND	5	
1,1-Dichloroethene	ug/L	ND	1.3	
Methylene Chloride	ug/L	ND	2.5	
trans-1,2-Dichloroethene	ug/L	ND	1	
1,1-Dichloroethane	ug/L	ND	0.7	
Chloroform	ug/L	ND	0.5	
1,1,1-Trichloroethane	ug/L	ND	0.5	
Carbon Tetrachloride	ug/L	ND	1.2	
Benzene	ug/L	ND	2	
1,2-Dichloroethane	ug/L	ND	0.5	
cis-1,3-Dichloropropene	ug/L	ND	3.4	
Trichloroethene	ug/L	ND	1.2	
1,1-Dichloropropane	ug/L	ND	0.5	

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Pace Project Number: 6019010

Client Project ID: Marco, KS

METHOD BLANK: 601650526

Associated Pace Samples:

601638547

601638554

Parameter	Units	Method Blank	PRL	Footnotes
		Result		
Bromodichloromethane	ug/L	ND	1	
Toluene	ug/L	ND	2	
1,1,2-Trichloroethane	ug/L	ND	0.5	
trans-1,3-Dichloropropene	ug/L	ND	0.6	
Tetrachloroethene	ug/L	ND	0.5	
Dibromochloromethane	ug/L	ND	0.9	
Chlorobenzene	ug/L	ND	0.7	
Ethylbenzene	ug/L	ND	2	
Bromoform	ug/L	ND	2	
1,1,2,2-Tetrachloroethane	ug/L	ND	0.5	
Xylene (Total)	ug/L	ND	7	
1,3-Dichlorobenzene	ug/L	ND	1	
1,4-Dichlorobenzene	ug/L	ND	1	
1,2-Dichlorobenzene	ug/L	ND	1	
Naphthalene	ug/L	ND	5	
Methyl-tert-butyl Ether	ug/L	ND	10	
Dichlorodifluoromethane	ug/L	ND	5	
a,a,a-Trifluorotoluene (S)	%	93		
1,4-Dichlorobutane (S)	%	92		

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 601648082 601648090									
Parameter	Units	Spike		Matrix Spike Result	Spike % Rec	Matrix Sp. Dup. Result	Spike % Rec	RPD	Footnotes
		601634819	Conc.						
Chloromethane	ug/L	0	20	12.90	64.5	18.61	93.0	36	1
Vinyl Chloride	ug/L	0.06202	20	18.51	92.3	19.97	99.5	8	
Bromomethane	ug/L	0	20	19.58	97.9	22.91	115	16	
Chloroethane	ug/L	0	20	18.58	92.9	26.19	131	34	2
Trichlorofluoromethane	ug/L	0.1339	20	19.91	98.9	20.92	104	5	
1,1-Dichloroethene	ug/L	0.1163	20	21.49	107	21.35	106	1	
Methylene Chloride	ug/L	0.4555	20	23.73	116	23.58	116	1	
trans-1,2-Dichloroethene	ug/L	0.1238	20	21.89	109	22.30	111	2	
1,1-Dichloroethane	ug/L	0	20	21.95	110	22.43	112	2	
Chloroform	ug/L	3.624	20	25.02	107	25.59	110	3	
1,1,1-Trichloroethane	ug/L	0	20	21.81	109	23.36	117	7	
Carbon Tetrachloride	ug/L	0.1766	20	22.08	110	22.14	110	0	
Bromine	ug/L	0	20	20.62	103	20.39	102	1	

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Pace Project Number: 6019010

Client Project ID: Marco, KS

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 601648082 601648090									
Parameter	Units	601634819	Spike Conc.	Matrix Spike Result	Spike % Rec	Matrix Sp. Dup. Result	Spike Dup % Rec	RPD	Footnotes
1,2-Dichloroethane	ug/L	0	20	21.77	109	21.31	106	2	
cis-1,3-Dichloropropene	ug/L	0	20	21.60	108	20.88	104	3	
Trichloroethene	ug/L	0.1692	20	21.86	108	22.60	112	3	
1,2-Dichloropropane	ug/L	0	20	21.85	109	21.63	108	1	
Bromodichloromethane	ug/L	1.653	20	22.92	106	22.69	105	1	
Toluene	ug/L	0.2827	20	20.66	102	20.35	100	2	
1,1,2-Trichloroethane	ug/L	0	20	20.91	105	20.97	105	0	
trans-1,3-Dichloropropene	ug/L	0	20	20.36	102	20.22	101	1	
Tetrachloroethene	ug/L	0.2196	20	21.31	106	21.83	108	2	
Dibromochloromethane	ug/L	0.6354	20	21.39	104	20.93	102	2	
Chlorobenzene	ug/L	0	20	20.47	102	19.73	98.6	4	
Ethylbenzene	ug/L	0.1896	20	20.56	102	20.13	99.7	2	
Bromoform	ug/L	0	20	20.45	102	20.39	102	0	
1,1,1,2-Tetrachloroethane	ug/L	0	20	20.26	101	21.16	106	4	
Xylene (Total)	ug/L	0.9311	60	61.80	101	61.33	101	1	
1,2-Dichlorobenzene	ug/L	0	20	19.99	99.9	18.96	94.8	5	
1,3-Dichlorobenzene	ug/L	0	20	19.88	99.4	18.76	93.8	6	
1,2-Dichlorobenzene	ug/L	0	20	19.99	99.9	18.99	95.0	5	
a,a,a-Trifluorotoluene (S)					95		101		
1,4-Dichlorobutane (S)					98		98		

## LABORATORY CONTROL SAMPLE: 601648108

Parameter	Units	Spike Conc.	LCS Result	Spike % Rec	Footnotes
Chloromethane	ug/L	20	19.37	96.9	
Vinyl Chloride	ug/L	20	19.85	99.3	
Bromomethane	ug/L	20	22.82	114	
Chloroethane	ug/L	20	23.64	118	
Trichlorofluoromethane	ug/L	20	20.02	100	
1,1-Dichloroethene	ug/L	20	21.28	106	
Methylene Chloride	ug/L	20	23.98	120	
trans-1,2-Dichloroethene	ug/L	20	21.50	107	
1,1-Dichloroethane	ug/L	20	22.69	113	
Chloroform	ug/L	20	22.73	114	
1,1,1-Trichloroethane	ug/L	20	21.88	109	
Carbon Tetrachloride	ug/L	20	21.29	106	
Benzene	ug/L	20	20.48	102	
1,2-Dichloroethane	ug/L	20	21.70	108	
cis-1,3-Dichloropropene	ug/L	20	21.03	105	

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Pace Project Number: 6019010

Client Project ID: Marco, KS

LABORATORY CONTROL SAMPLE: 601648108

Parameter	Units	Spike Conc.	LCS Result	Spike X Rec	Footnotes
Trichloroethene	ug/L	20	21.52	108	
1,2-Dichloropropane	ug/L	20	22.06	110	
Bromodichloromethane	ug/L	20	21.55	108	
Toluene	ug/L	20	20.50	102	
1,1,2-Trichloroethane	ug/L	20	22.31	112	
trans-1,3-Dichloropropene	ug/L	20	20.81	104	
Tetrachloroethene	ug/L	20	21.83	109	
Dibromochloromethane	ug/L	20	21.61	108	
Chlorobenzene	ug/L	20	20.70	104	
Ethylbenzene	ug/L	20	20.59	103	
Bromoform	ug/L	20	20.89	104	
1,1,2,2-Tetrachloroethane	ug/L	20	21.92	110	
Xylene (Total)	ug/L	60	61.93	103	
1,3-Dichlorobenzene	ug/L	20	20.60	103	
1,4-Dichlorobenzene	ug/L	20	20.53	103	
o-chlorobenzene	ug/L	20	20.91	105	
a.o.a-Trifluorotoluene (S)				96	
1,4-Dichlorobutane (S)				97	

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GOLDER ASSOCIATES INC  
200 UNION BOULEVARD  
SUITE 500  
LAKEWOOD, CO 80228

Pace Project Number: 6019010  
Client Project ID: Marco, KS

Attn: Mr. RANDY MARCH  
Phone: (303)980-0540

QC Batch ID: 40165  
Analysis Method: EPA 8021  
Associated Pace Samples:

QC Batch Method: 5030 Med Lvl Soil  
Analysis Description: Halogen. & Aromatic Vol. Orgs.  
601638414 601638471 601638497

METHOD BLANK: 601652787

Associated Pace Samples:

601638414 601638471 601638497

Parameter	Units	Method	PRL	Footnotes
		Blank Result		
Chloromethane	ug/kg	530	20	
Vinyl Chloride	ug/kg	ND	46	
Bromomethane	ug/kg	ND	76	
Chloroethane	ug/kg	ND	130	
Trichlorofluoromethane	ug/kg	ND	130	
1,1-Dichloroethene	ug/kg	ND	34	
Methylene Chloride	ug/kg	ND	64	
trans-1,2-Dichloroethene	ug/kg	ND	26	
1,1-Dichloroethane	ug/kg	ND	18	
Chloroform	ug/kg	ND	13	
1,1,1-Trichloroethane	ug/kg	ND	13	
Carbon Tetrachloride	ug/kg	ND	30	
Benzene	ug/kg	ND	50	
1,2-Dichloroethane	ug/kg	ND	13	
cis-1,3-Dichloropropene	ug/kg	ND	86	
Trichloroethene	ug/kg	ND	30	
1,2-Dichloropropane	ug/kg	ND	13	
Bromodichloromethane	ug/kg	ND	26	
Toluene	ug/kg	ND	50	
1,1,2-Trichloroethane	ug/kg	ND	13	
trans-1,3-Dichloropropene	ug/kg	ND	15	
Tetrachloroethene	ug/kg	ND	13	
Dibromochloromethane	ug/kg	ND	24	
Chlorobenzene	ug/kg	ND	18	
Ethylbenzene	ug/kg	ND	50	

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Pace Project Number: 6019010  
Client Project ID: Marco, KS

METHOD BLANK: 601652787

Associated Pace Samples:

601638414 601638471 601638497

Parameter	Units	Method	PRL	Footnotes
		Blank Result		
Bromoform	ug/kg	ND	50	
1,1,2,2-Tetrachloroethane	ug/kg	ND	13	
Xylene (Total)	ug/kg	ND	180	
1,3-Dichlorobenzene	ug/kg	ND	26	
1,4-Dichlorobenzene	ug/kg	ND	26	
1,2-Dichlorobenzene	ug/kg	ND	26	
Naphthalene	ug/kg	ND	130	
Methyl-tert-butyl Ether	ug/kg	ND	260	
Dichlorodifluoromethane	ug/kg	ND	70	
a,a,a-Trifluorotoluene (S)	μ	85		
1,4-Dichlorobutane (S)	μ	97		

Parameter	Units	Matrix Spike & MATRIX SPIKE DUPLICATE: 601652795 601652803		Matrix Spike Result	Matrix Spike % Rec	Matrix Sp. Dup. Result	Matrix Spike Dup % Rec	RPD	Footnotes
		601638414	Spike Conc.						
Chloromethane	ug/kg	399.4	498.3	1255	172	1366	194	12	3
Vinyl Chloride	ug/kg	6.067	498.3	343.8	67.8	330.6	65.0	4	
Bromomethane	ug/kg	15.92	498.3	69.99	10.9	71.46	11.1	2	
Chloroethane	ug/kg	0	498.3	363.3	72.9	379.5	76.0	4	
Trichlorofluoromethane	ug/kg	0	498.3	425.5	85.4	400.9	80.3	6	
1,1-Dichloroethene	ug/kg	2.671	498.3	467.9	93.4	440.9	87.7	6	
Methylene Chloride	ug/kg	43.42	498.3	531.6	98.0	519.4	95.3	3	
trans-1,2-Dichloroethene	ug/kg	2.635	498.3	479.6	95.7	451.5	89.9	6	
1,1-Dichloroethane	ug/kg	0	498.3	512.0	103	485.7	97.2	6	
Chloroform	ug/kg	4.392	498.3	516.2	103	500.2	99.3	3	
1,1,1-Trichloroethane	ug/kg	0	498.3	516.5	104	486.9	97.5	6	
Carbon Tetrachloride	ug/kg	2.524	498.3	482.7	96.4	450.2	89.6	7	
Benzene	ug/kg	0	498.3	492.3	98.8	472.0	94.5	4	
1,2-Dichloroethane	ug/kg	2.766	498.3	481.2	96.0	488.9	97.3	1	
cis-1,3-Dichloropropene	ug/kg	1.833	498.3	526.3	105	519.6	104	2	
Trichloroethene	ug/kg	4.144	498.3	547.2	109	528.1	105	4	
1,2-Dichloropropane	ug/kg	0	498.3	526.0	106	527.3	106	0	
Bromodichloromethane	ug/kg	0	498.3	497.0	99.8	487.8	97.7	2	
Toluene	ug/kg	0	498.3	521.7	105	501.9	100	4	
1,1,2-Trichloroethane	ug/kg	3.097	498.3	525.8	105	530.2	106	1	
trans-1,3-Dichloropropene	ug/kg	2.324	498.3	528.0	106	515.5	103	3	

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Pace Project Number: 6019010  
Client Project ID: Marco, KS

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 601652795 601652803									
Parameter	Units	601638414	Spike Conc.	Matrix Spike Result	Spike % Rec	Matrix Sp. Dup. Result	Spike Dup % Rec	RPD	Footnotes
Tetrachloroethene	ug/kg	5.443	498.3	549.9	109	538.7	107	2	
Dibromochloromethane	ug/kg	0	498.3	498.5	100	493.7	98.8	1	
Chlorobenzene	ug/kg	0	498.3	529.7	106	519.6	104	2	
Ethylbenzene	ug/kg	0	498.3	536.2	108	515.3	103	4	
Bromoform	ug/kg	0	498.3	474.9	95.3	471.8	94.5	1	
1,1,2,2-Tetrachloroethane	ug/kg	0	498.3	525.4	105	526.7	105	0	
Xylene (Total)	ug/kg	11.05	1495	1617	107	1553	103	4	
1,3-Dichlorobenzene	ug/kg	4.639	498.3	528.6	105	523.7	104	1	
1,4-Dichlorobenzene	ug/kg	6.614	498.3	523.6	104	524.4	104	0	
1,2-Dichlorobenzene	ug/kg	5.772	498.3	516.7	102	521.9	103	1	
a,a,a-Trifluorotoluene (S)					90		88		
1,4-Dichlorobutane (S)					98		100		

## LABORATORY CONTROL SAMPLE: 601652811

Parameter	Units	Spike Conc.	LCS Result	Spike % Rec	Footnotes
Chloromethane	ug/kg	500	432.0	86.4	
Vinyl Chloride	ug/kg	500	345.1	69.0	
Bromomethane	ug/kg	500	148.4	29.7	
Chloroethane	ug/kg	500	539.4	108	
Trichlorofluoromethane	ug/kg	500	461.5	92.3	
1,1-Dichloroethene	ug/kg	500	506.0	101	
Methylene Chloride	ug/kg	500	604.3	121	
trans-1,2-Dichloroethene	ug/kg	500	534.7	107	
1,1-Dichloroethane	ug/kg	500	576.0	115	
Chloroform	ug/kg	500	590.7	118	
1,1,1-Trichloroethane	ug/kg	500	602.0	120	
Carbon Tetrachloride	ug/kg	500	523.0	105	
Benzene	ug/kg	500	515.3	103	
1,2-Dichloroethane	ug/kg	500	548.8	110	
cis-1,3-Dichloropropene	ug/kg	500	524.2	105	
Trichloroethene	ug/kg	500	583.1	117	
1,2-Dichloropropane	ug/kg	500	565.9	113	
Bromodichloromethane	ug/kg	500	524.1	105	
Toluene	ug/kg	500	526.8	105	
1,1,2-Trichloroethane	ug/kg	500	562.3	112	
trans-1,3-Dichloropropene	ug/kg	500	496.4	99.3	
Tetrachloroethene	ug/kg	500	582.7	117	
Dibromochloromethane	ug/kg	500	500.6	100	

## REPORT OF LABORATORY ANALYSIS

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## QUALITY CONTROL DATA

DATE: 12/29/97

PAGE: 35

Pace Project Number: 6019010

Client Project ID: Marco, KS

LABORATORY CONTROL SAMPLE: 601652811

Parameter	Units	Spike Conc.	LCS Result	Spike % Rec	Footnotes
Chlorobenzene	ug/kg	500	520.4	104	
Ethylbenzene	ug/kg	500	533.2	107	
Bromoform	ug/kg	500	478.9	95.8	
1,1,2,2-Tetrachloroethane	ug/kg	500	550.3	110	
Xylene (Total)	ug/kg	1500	1578	105	
1,3-Dichlorobenzene	ug/kg	500	492.1	98.4	
1,4-Dichlorobenzene	ug/kg	500	485.4	97.1	
1,2-Dichlorobenzene	ug/kg	500	486.8	97.4	
a,a,a-Trifluorotoluene (S)				104	
1,4-Dichlorobutane (S)				98	

## REPORT OF LABORATORY ANALYSIS

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## QUALITY CONTROL DATA PARAMETER FOOTNOTES

Consistent with EPA guidelines unrounded concentrations are displayed and have been used to calculate % Rec and RPD values.

ND Not Detected

NC Not Calculable

PRL Pace Reporting Limit

RPD Relative Percent Difference

(S) Surrogate

[1] The calculated RPD was outside QC acceptance limits.

[2] The calculated RPD was outside QC acceptance limits.

[3] Spiked sample recovery is not within control limits.

## REPORT OF LABORATORY ANALYSIS

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## CHAIN-OF-CUSTODY RECORD Analytical Request

Client	Report To: <u>1000 W. 1st</u>	Turn around Time	Pace Client No.
Address	Bill To: <u>State</u>	<input type="checkbox"/> 24 Hours <input type="checkbox"/> 48 Hours <input type="checkbox"/> 3-5 Days <input type="checkbox"/> 1 Week <input checked="" type="checkbox"/> Normal 14 Days	Pace Project Manager
Phone	P.O. # / Billing Reference		Pace Project No. <u>601920</u>
	Project Name / No.		*Requested Due Date:

Sampled By (PRINT): <u>[Signature]</u>	Analyses Request	REMARKS
Sampler Signature	PRESERVATIVES UNPRESERVED <input checked="" type="checkbox"/> $H_2SO_4$ <input checked="" type="checkbox"/> $HNO_3$ <input checked="" type="checkbox"/> VOA (HCL) <input checked="" type="checkbox"/> NaOH <input checked="" type="checkbox"/> $Na_2S_2O_3$	
Date Sampled	NO. OF CONTAINERS	

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
1	Pipe ID	10:00	S	1008414	1008414	10/1/11	10:00	1008414	10/1/11	10:00
2	Pipe ID	10:00	W	1008414	1008414	10/1/11	10:00	1008414	10/1/11	10:00
3	Tip Blank		W	1008414	1008414	10/1/11	10:00	1008414	10/1/11	10:00
4										
5										
6										
7										
8										

COOLER NOS.	BAILERS	SHIPMENT METHOD	OUT/DATE	RETURNED/DATE	ITEM NUMBER

Additional Comments

### SAMPLE CONDITION

Temp: _____ °C	Received on Ice: Y / N	Sealed Cooler: Y / N	Samples Intact: Y / N	pH _____
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SEE REVERSE SIDE FOR INSTRUCTIONS



## CHAIN-OF-CUSTODY RECORD Analytical Request

Client	Report To:	Turn around Time	Pace Client No.
Address	Bill To:	<input type="checkbox"/> 24 Hours <input type="checkbox"/> 48 Hours <input type="checkbox"/> 3-5 Days <input type="checkbox"/> 1 Week <input checked="" type="checkbox"/> Normal 14 Days	Pace Project Manager
Phone	P.O. # / Billing Reference		Pace Project No.
	Project Name / No.		*Requested Due Date:

Sampled By (PRINT):	NO OF CONTAINERS	PRESERVATIVES	ANALYSES REQUEST	REMARKS
Sampler Signature				

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	COOLER NOS.	BAILERS	SHIPMENT METHOD	OUT/DATE	RETURNED/DATE	ITEM NUMBER	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
1	17-01-12	1117	S	60 1638411												
2	17-01-12		W	60 1638419												
3																
4																
5																
6																
7																
8																

Additional Comments

SAMPLE CONDITION			
Temp. _____ °C	Received on Ice: Y / N	Sealed Cooler: Y / N	Samples Intact: Y / N



## CHAIN-OF-CUSTODY RECORD Analytical Request

Client		Report To:		Turn around Time		Pace Client No.	
Address		Bill To:		<input type="checkbox"/> 24 Hours <input type="checkbox"/> 48 Hours <input type="checkbox"/> 3-5 Days <input type="checkbox"/> 1 Week <input checked="" type="checkbox"/> Normal 14 Days		Pace Project Manager	
Phone		P.O. # / Billing Reference				Pace Project No.	
Sampled By (PRINT)		Project Name / No.				*Requested Due Date:	
Sampler Signature		Date Sampled					

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	PRESERVATIVES				ANALYSES REQUEST	REMARKS
					UNPRESERVED	H <sub>2</sub> SO <sub>4</sub>	HNO <sub>3</sub>	VOA (HCL)		
1	100-100-100	100	100	100	X					
2	100-100-100	100	100	100			2			
3	100-100-100	100	100	100						
4	100-100-100	100	100	100	2					
5	100-100-100	100	100	100	2		2			
6	100-100-100	100	100	100	2					
7										
8										

COOLER NOS.	BAILERS	SHIPMENT METHOD		RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
		OUTDATE	RETURNE DATE						

SAMPLE CONDITION			
Temp: _____ °C	Received on Ice: Y / N	Sealed Cooler: Y / N	Samples Intact: Y / N

Additional Comments



# Pace Analytical

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## CHAIN-OF-CUSTODY RECORD Analytical Request

Client	Report To:	Turn around Time <input type="checkbox"/> 24 Hours <input type="checkbox"/> 48 Hours <input type="checkbox"/> 3-5 Days <input type="checkbox"/> 1 Week <input checked="" type="checkbox"/> Normal 14 Days	Pace Client No.
Address	Bill To:		Pace Project Manager
	P.O. # / Billing Reference		Pace Project No. 6019210
Phone	Project Name / No. 6019210		*Requested Due Date:

Sampled By (PRINT):	Analyses Request	Remarks
Sampler Signature	Preservatives H <sub>2</sub> SO <sub>4</sub> HNO <sub>3</sub> VOA (HCL) NaOH Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	
Date Sampled	NO. OF CONTAINERS	

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
1	100 ml	100	100	1638534	100	100	100	100	100	100
2	100 ml	100	100	1638534	100	100	100	100	100	100
3	100 ml	100	100	1638534	100	100	100	100	100	100
4										
5										
6										
7										
8										

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT/DATE	RETURNED/DATE	ITEM NUMBER	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
Additional Comments										
Temp. °C Received on Ice: Y / N Sealed Cooler: Y / N Samples Intact: Y / N pH										

red trip blank

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